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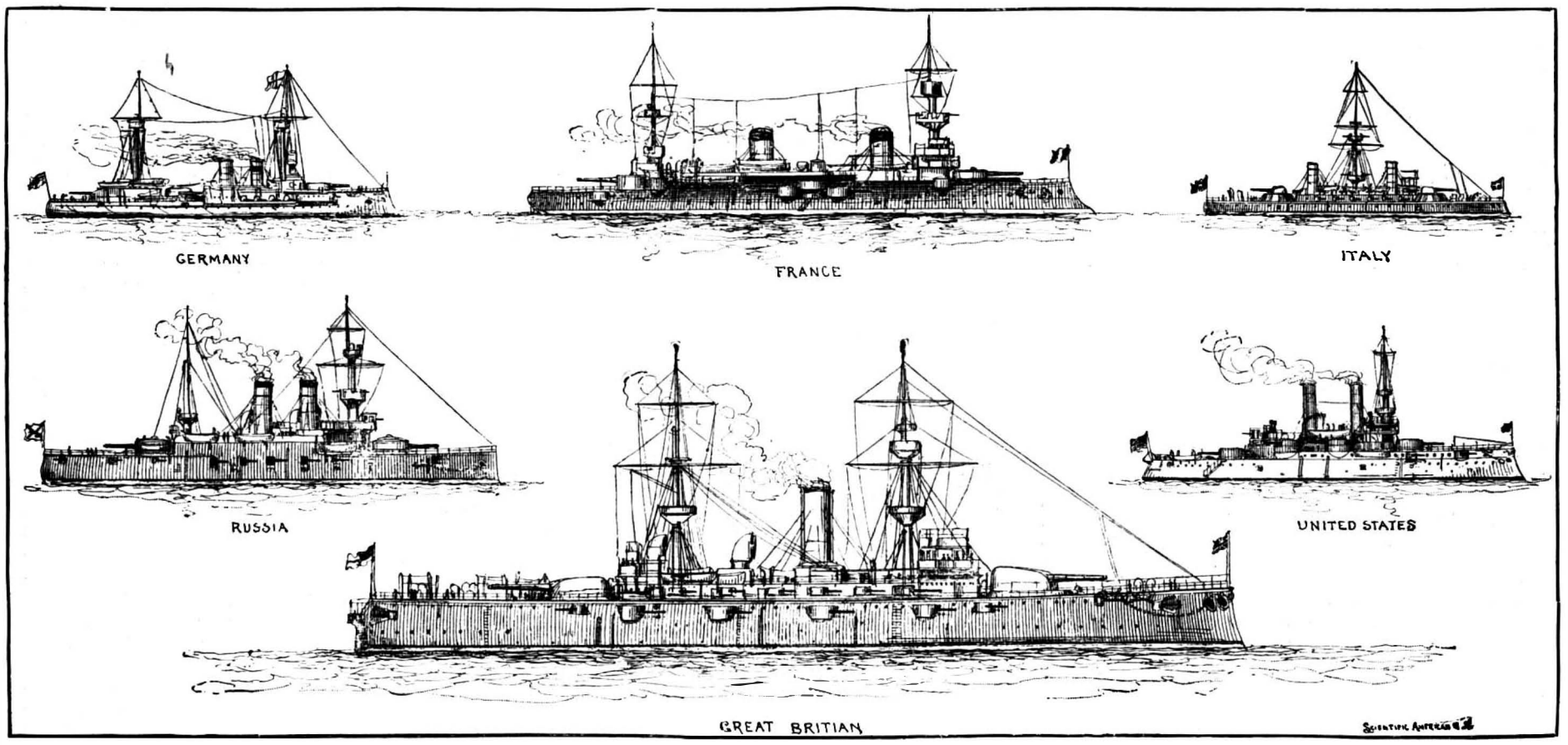

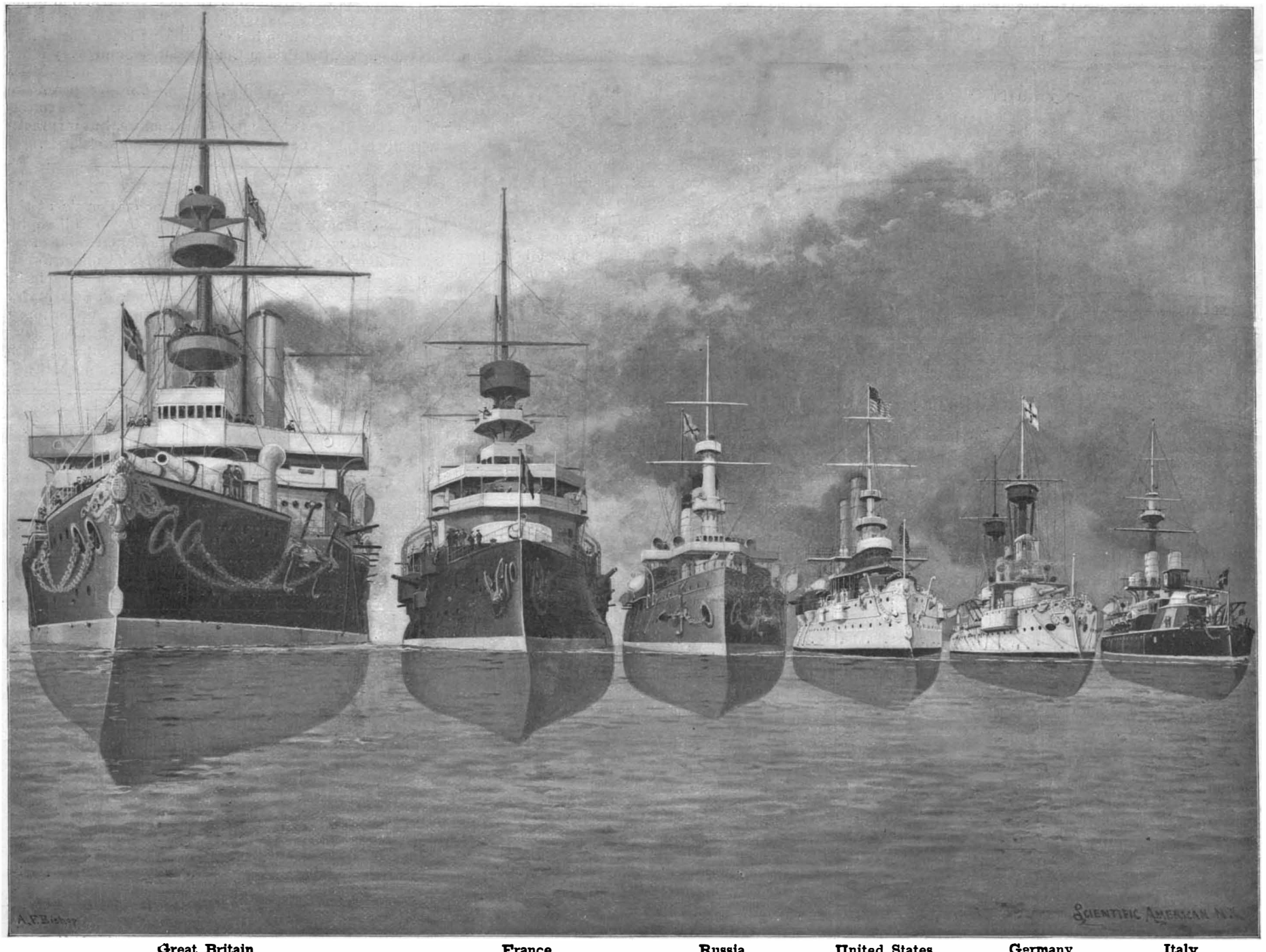

Great Britain.	France.	Russia.	United States.	Germany.	Italy.
1,557,522 tons.	731,629 tons.	453,899 tons.	303,070 tons.	299,687 tons.	286,175 tons.

Broadside and bow views of typical battleships, representing relative size of leading navies.

COMPARATIVE STRENGTH OF THE WORLD'S NAVIES.—[See page 422.]

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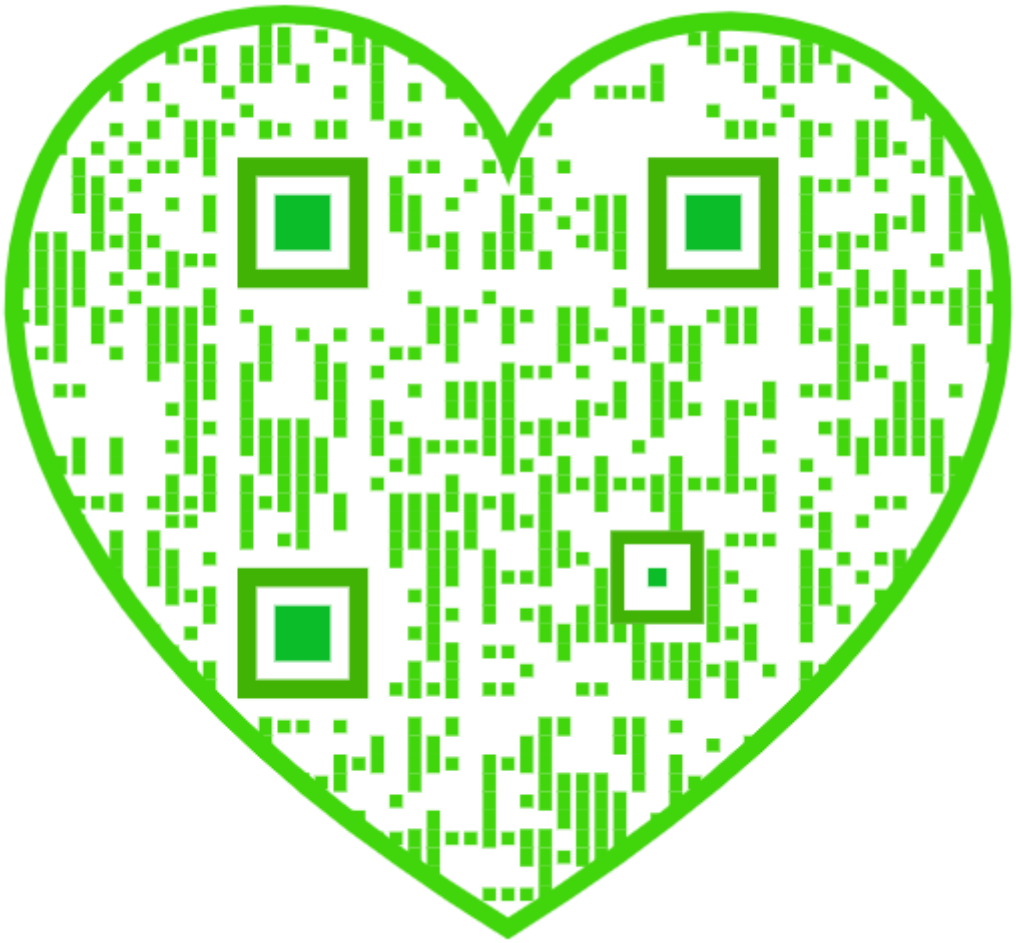

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NEW YORK, SATURDAY, DECEMBER 31, 1898.

A THIRTY-FIVE FOOT CHANNEL FOR NEW YORK HARBOR.

It begins to look as though the much needed improvement of the entrance to New York Harbor was at last to be carried out, by providing a channel proportionate in depth and width to the traffic of this port, which, if it is not already, soon will be the most important in the world. As matters now stand, the main channel is both tortuous and shallow. After leaving the Narrows, and rounding Norton's Point at the southwestern extremity of Coney Island, it does not turn eastward toward the open sea, but keeps due south for several miles until it is well inside of Sandy Hook, and then makes a sharp turn of 90 degrees to the eastward, access to deep water being finally had by way of the Gedney Channel.

At the first blush it looks like perversion of the truth to designate as shallow a channel having a depth of 30 feet of water, which is the present depth of the New York entrance; but in matters nautical the term is a strictly relative one, and water that might be ample for one class of harbor and traffic can easily be shallow for another. So also it is true that a channel depth that might be sufficient in one decade may be quite insufficient to meet the requirements of the decade that follows. A few years ago, when 28 feet was the maximum draught of a few of the largest liners, the present channel was equal to accommodating the traffic, at least as far as the depth was concerned; but so rapid has been the growth in the dimensions of freight and passenger steamers, that there are ships afloat that leave the harbor drawing over 32 feet; and ships are being built that may easily draw 34 feet when fully loaded. At present such vessels, if they wish to carry out a full cargo, must wait for high water, an impediment that cannot fail to be injurious to the interests of the harbor.

But the present channel is not only shallow for modern traffic, but by reason of its tortuous character and restricted width it is difficult to navigate. This is proved by the large number of steamships that get aground in making the turns or in passing each other within the channel's narrow limits. As we have said, the main channel makes one turn of 90 degrees, and there are others of less magnitude to navigate before deep water is gained. The difficulty arising from this cause is increasing with the increase in the length of ocean liners. The "City of New York," which made her appearance only ten years ago, was considered an abnormally long vessel, her over-all dimensions being 560 feet. Since her day we have seen the advent of the "Campania," 620 feet, and the "Kaiser Wilhelm der Grosse," 649 feet in length, to this port, while in the coming season the White Star Line will place on the route a mammoth vessel, the "Oceanic," whose extreme length will be 704 feet.

The proposed changes will provide for the improvement of all existing channels; but by far the most important recommendation is that included in General Ludlow's report. The Ludlow survey recommends the abandonment of the main channel and the substitution of the present East Channel as the principal waterway for large vessels. To give it the necessary capacity, it is to be dredged out to a minimum depth of 35 feet and a minimum width of 1,500 feet. This would shorten the distance to the open sea by about five miles, and would provide a straight channel in place of the present circuitous and difficult route. The largest vessels now under construction would be able to enter and leave the harbor at any hour, irrespective of the state of the tide, and at their fullest draught, which in the case of several ships is likely to be fully 34 feet.

The estimated cost of the work is between $3,500,000 and $4,000,000, and in view of the great importance of the harbor and the great benefit that the improvement would confer, we do not think the cost is by any means excessive. The matter will come up at an early date for the consideration of Congress, and it is sincerely to be hoped that a scheme which has such obvious merit will be met with unanimous approval.

AMERICAN LOCOMOTIVES FOR AN ENGLISH RAILWAY.

The introduction of American locomotives on English railways was merely a matter of time, and it only needed the accident of English locomotive builders being overstocked with orders to open the door.

It seems that the prosperity which marks the shipbuilding trade in Great Britain is being shared by the locomotive trade, and when the Midland Railway wished to place a "rush" order for twenty freight locomotives, they were compelled to come to this country to get it filled. The present activity is in part accounted for by the fact that the recent strike in the engineering trades has thrown the locomotive works in arrears. Ten of the engines are to be built by the Baldwin and ten by the Schenectady works. They are to be of the American Mogul type, with cylinders 18 inches in diameter by 24 inches stroke, and with such modifications in details as are required to conform to British practice.

The introduction of these engines in regular service on an English road will be watched with the greatest interest. They are not of abnormal dimensions, being smaller than the average freight engines now being built for use on our own roads but of the standard size of the freight engines in use on the Midland Railway. This is fortunate, as giving for the first time an opportunity to test the English and American types under identical conditions of service. The cost of the engines, even should the customary English copper fire-box and other specialties be called for, will probably be from twenty-five to thirty per cent less than if they were of home manufacture; and if they render equally efficient service, as we do not doubt they will, the result cannot fail to have an important bearing on the locomotive trade in that country.

The Midland Railway has always been the most progressive of the English roads. It was this company that led the way in the introduction of American cars into Great Britain, and nearly a quarter of a century ago a "dining car train," including, if we remember rightly, two Pullman cars, was running daily between London and Leeds.

THE GATLING CAST STEEL GUN.

Great interest attaches to the government tests of the 8-inch cast steel gun designed by Dr. Gatling of machine gun fame. It is the object of Dr. Gatling to produce a gun which shall possess all the ballistic qualities of the prevailing type of hooped or built-up gun without its excessive cost. The present built-up system is founded upon the method introduced by our General Rodman during the Civil War, who, in order to compress the interior metal of the gun, cooled the gun from the inside, thus causing the exterior layers to shrink with tremendous gripping effect upon the bore. The same effect is secured in forged steel guns by shrinking successive hoops of steel upon an interior tube. Rodman's method was cheap and rapid; the present method is slow and very costly.

Of late years several attempts have been made to dispense with the hooped construction and produce a steel gun of one integral forging or casting. In 1895 Maxim made a 5-inch gun of a single forging and cooled it from the inside by running a stream of coal oil through the bore. In the firing test his gun showed a velocity of 2,200 feet per second with a pressure of 33,600 pounds to the square inch, and withstood a maximum pressure of 50,400 pounds without injury. In January of this year a single-forging steel gun, designed by Capt. F. E. Hobbs, of the Ordnance Department, United States Army, was tested at Sandy Hook with excellent results, a velocity of 2,700 feet being attained with a pressure of 50,000 pounds to the square inch.

Dr. Gatling is endeavoring to go one step further and cheapen gun construction by dispensing as far as possible with forging processes and casting his gun direct from the cupola. It is evident that if a reliable cast steel gun can be manufactured, the cost and time consumed in heavy gun construction will be greatly reduced—according to Gatling, fully 50 per cent. The metal used is a special steel alloy, and the gun is cast in a vertical position, muzzle downward. An attempt is made to impart a fibrous character to the casting by giving a swirling motion to the steel as it enters the mould, and Dr. Gatling states that a certain amount of forging of the interior is effected by the use of a rotary mandrel when the gun is red hot in the annealing furnace. The desired compression and tension are secured by cooling from the interior. In the preliminary tests the gun has withstood a pressure of 37,000 pounds to the square inch. This is satisfactory as far as it goes, but with the records of 50,400 and 50,000 pounds pressure in the Maxim and Hobbs guns and 82,850 pounds pressure in the Brown wire gun ahead of it, the cast steel gun has a long road to travel before it eclipses its predecessors. If it equals these pressures and survives the 300 rounds to which the government officials will subject it, Dr. Gatling will have made an invaluable contribution to the science and art of heavy gun construction, and it will only remain to overcome the undoubted prejudice which modern artillerists entertain against cast as compared with forged or wire-wound ordnance.

ENLARGING THE CAPACITY OF THE BROOKLYN BRIDGE.

The present Mayor of New York is no doubt a better lawyer than engineer; for after throwing out the city's obviously most urgent engineering work, the Rapid Transit tunnel, he wishes to have under construction across the East River three great bridges whose aggregate cost will greatly exceed that of the rejected tunnel scheme, and whose construction will take three or four times as long to complete. In addition to the new East River bridge, whose construction is not much more than fairly under way, he would build another at Blackwell's Island and a third midway between the new bridge and the present New York and Brooklyn structure.

The Blackwell's Island bridge would be a distinct benefit; but the other structure would be quite superfluous. And for this reason: that it would be possible, as we have pointed out more than once in these columns, so to strengthen and enlarge the present bridge as to practically double its capacity. We should thus obtain practically all the advantages of Mayor Van Wyck's proposed new bridge for about one-fifth or one-sixth the cost.

Mr. William H. Hildenbrand, the engineer to whom Mr. Roebling intrusted the task of making all the calculations as to strength, stability, etc., of the Brooklyn bridge at the time of its erection, states that he has prepared a plan for doubling the capacity of the structure at a maximum cost of $2,500,000. He would raise the height of the towers some 10 or 12 feet, and suspend four auxiliary cables above and in the same plane as the present cables. The present stiffening trusses, six in all, would be replaced by new and deeper trusses of a common depth, and upon their upper chords, on either side of the footway, would be an upper floor reaching across the present railroad tracks and roadway. This would double the capacity of the bridge for wagon and car traffic. The footway is sufficient for all probable increase in the number of foot passengers. The pull of the new cables would be taken by additional anchorages placed behind the present anchorages.

Mr. Hildenbrand's name is a guarantee that the scheme is feasible, for he has recently made a similar enlargement of the old Cincinnati bridge, built thirty years ago, the strength of the new construction being double that of the original bridge. Now this is an improvement which has everything to recommend it to the Mayor, the Bridge Commissioners, and every other person who is desirous of improving transit facilities between New York and Brooklyn. For an expenditure of $2,500,000 we not only remove all anxiety as to the serviceableness of the present structure, but we practically secure a new bridge between the two islands.

THE FORESTS OF THE WORLD.

Mr. D. E. Hutchins, Conservator of Forests at the Cape, recently read before the Cape Town Philosophical Society a paper showing the need and value of extending the area in the colony at present under forest. Cape Colony stands far below other countries in its proportion of forest, though the climate of the country is such that it ought to have a percentage under forest at least equal to Germany. The following table shows the area under forest in the colony compared with that in some other countries:

Countries.	Area under forest in acres.	Percentage under forest of total area of country.
Russia in Europe	527,427,000	42
Sweden	42,366,000	42
Austria	46,856.000	31
Germany	34,350,000	26
Norway	18.920,000	25
India	140,000,000	25
France	20,750,000	16
Portugal	1,666,000	5
Great Britain and Ireland	2,790,000	4
Cape Colony	353.280	0·29

Mr. Hutchins suggests that plantations should be formed in districts within minimum rainfall limits of 15 or 20 inches per annum. The argument which will perhaps appeal most forcibly to Cape agriculturists is that, while the total value of the fruit produced in Cape Colony is £100,000, no less than £269,349 have been paid for wood imported into the colony during the last two years, nearly the whole of which would be produced in national forests covering an area of about 50,000 acres. That forests can thrive where agriculture is difficult or impossible, is shown by the steep richly wooded slopes of the lofty Amatolas, the similarly beautiful forest with its gigantic yellow-wood trees in the barren Knysna country, and, perhaps most striking of all, the cedar trees of Clanwilliam, growing on the absolutely bare rocks of the stupendous Cedarberg Range; while at Glenadendal an introduced tree, the cluster pine, hardier than any of the indigenous trees, is spreading itself self-sown up the rocky mountain side, in spite of fires, drought, hot winds, and climatic vicissitudes, that are too often the despair of the agriculturist.

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CALCIUM CARBIDE IN NEW YORK CITY.

The Fire Commissioner of New York City has taken steps to regulate the trade in calcium carbide. Owing to the fact that this substance is now stored in most of the sporting goods houses and bicycle stores in the city, it has seemed necessary to take some steps regarding the matter, as the gas is generated by coming in contact with water, and it will readily be seen that it might cause a disastrous explosion, if kept in considerable quantities, in case of a fire. According to the new rules, all calcium carbide in transit through the city and in storage must be in hermetically sealed iron receptacles and marked plainly "Calcium Carbide. Dangerous if not kept dry." No single package must exceed 100 pounds. As to the sale of the carbide, not more than 20 pounds, either in bulk or in cartridges, can be stored or kept in any building used for a dwelling or mercantile purpose, and this amount can only be kept on a permit obtained from the Fire Department. This permit will provide that quantities in cases of 2 pounds shall be in tight metal packages and kept elevated at least 6 inches from the floor in a fireproof safe above the street grade. The manufacture, transportation, storage, selling, or use of liquefied acetylene is absolutely prohibited within the city limits. Provision is made for the storage of calcium carbide in sealed receptacles in quantities not exceeding 100 pounds in isolated buildings of fireproof construction. The storage must also be with a permit from the Fire Department, and the entire quantity stored must not exceed 500 pounds in the aggregate.

THE HEAVENS IN JANUARY.

BY GARRETT P. SERVISS.

At 10 o'clock P. M. in the middle of January the array of constellations is the finest that the heavens, in our latitudes, ever present. Orion is on the meridian, in the most favorable position for the exhibition of his splendors. The two great stars that adorn his shoulder and his foot, Betelgeuse and Rigel, show their contrast of colors admirably, sparkling through the crisp air. Betelgeuse glows like a Brazilian topaz, while Rigel's light is of diamond purity. Midway between them glitters the Belt, with its three bright stars in a row, so accurately spaced and aligned that they seem to have just obeyed the command, "Eyes front!" In themselves they would hold attention, but on a dark, clear night the sky about them is seen to be sprinkled with a multitude of tiny stars, whose twinkling affects the eye like half-illuminated frostwork. Below the Belt hangs the Sword, sheathed in the mysterious haze of the Great Nebula.

Following the direction indicated by the stars of the Belt, downward toward the left hand, at a distance of some twenty degrees, the eye is led to Sirius, ablaze, if the air be a little unsteady, with prismatic hues. The spectacle of Sirius shining above a snow-clad hill on a January night is a surprising revelation of the power of a star to enhance the beauty of a terrestrial landscape.

Westward from Orion runs the winding "river of stars," Eridanus, with Cetus just setting beyond it, while toward the east, above Sirius, appears Monoceros, followed by the interminable Hydra, dragging its slow length above the horizon.

Next in attractiveness to Orion and his immediate neighbors, which include Auriga, with the brilliant Capella, nearly overhead, is the winter arch of the Zodiac, beginning at the level of the hills in the west with Pisces, and rising through Aries to Taurus (the tip of whose horns touches the meridian above Orion), and then descending in the east through Gemini, Cancer and Leo, to Virgo, whose westernmost stars are just poised on the horizon.

Under Gemini and Cancer, the latter being easily recognized by the glimmer of the beehive cluster, shines Procyon, the leading star of Canis Major.

Glancing northwestward, Perseus, Andromeda, and Pegasus are seen aligned in a downward slope to the horizon, while Cassiopeia's "W" shines between them and the Pole, balanced against the Great Dipper, which is rising, bowl upward, in the northeast.

THE PLANETS.

Mercury is a morning star, in the constellation Sagittarius. It reaches its greatest western elongation on January 11, when it may be seen nearly two hours before sunrise.

Venus is a morning star, and very brilliant, rising, at the beginning of the month, about 4:30 A. M. It travels from Scorpio into Ophiuchus. On the 25th it will be in conjunction with Saturn.

Mars has become the "star" of the planetary company, being in opposition to the sun on January 18, and therefore visible the entire night. It is in the constellation Gemini. On the 15th it will be about 60,000,000 miles from the earth, so that a telescope magnifying 250 diameters will bring it within an apparent distance equal to the real distance of the moon. A comparison of the lunar features seen by the naked eye with those of Mars seen with the telescopic power mentioned will be an object lesson in the difficulties of planetary observation. This is a very unfavorable opposition of Mars, but its red color and its conspicuous position will serve to attract all eyes.

Jupiter, in the constellation Libra, is a morning star, rising, at the opening of the month, soon after 2 A. M.

Saturn is also a morning star, in the constellation Ophiuchus. It rises on the 1st about 5:40 A. M., and those who get up early to see Mercury about the 11th will enjoy a sight of the ringed planet also, as well as of the brilliant Venus.

Uranus is a morning star in Scorpio and Neptune an evening star in Taurus.

THE MOON.

January begins with the moon approaching last quarter, that phase being reached on the 4th. New moon occurs on the 11th, first quarter on the 18th, and full moon on the 26th.

MISCELLANEOUS.

There will be a partial eclipse of the sun on January 11, visible along the North Pacific coast.

A meteoric shower is due on the night of January 2, the radiant point being in the constellation Draco. These meteors, which are described by Mr. Denning as swift and making long streaks, should be looked for in the north, under the Pole Star.

There will be a minimum of the variable star Algol on the 19th, about 7 P. M.

AN ARCTIC RAILROAD.

BY PROF. J. H. GORE.

Several years ago, when the railroad was built from the head of the Gulf of Bothnia to the iron mines of Gelivara, it was thought that the limit of Arctic engineering had been reached. If the practical results of this road had come up to the expectations of its promoters, it is quite likely that no second attempt would have been made to erect and maintain a road lying wholly within the frozen zone.

The ore from this region contains from 68 to 70 per cent of iron, but having a little more than one per cent of phosphorus, it yields to only a few of the many reduction processes, notably the furnaces constructed on the Siemens-Martin principle. Such works as those at Stettin find it profitable to ship this ore from the Swedish mines, bring the coal from England, and place the iron on the market in competition with iron that comes from countries where the raw materials are found side by side.

In Luleaa, the ore costs about $2 per ton, and the freight to Stettin or Westphalia amounts to $2.25 per ton, since the vessels must return, at least for a greater part of the way, in ballast. However, the chief difficulty is not in the matter of cost of transportation, but it lies in the fact that the northern part of the Gulf of Bothnia is open only about four and one-half months out of the year. In this short period, however, the annual shipments are 800,000 tons. Another incentive for the construction of a better avenue for export is the increasing demand in England for this grade and character of ore, to take the place of Spanish ores, which are growing scarce and more difficult to obtain. The English reducers find that by mixing the Gelivara ores with their own poorer ores they can obtain, in their high furnaces, 55 per cent of excellent iron.

With any number of open harbors on the Norwegian coast, it was seen that a railroad built directly across Sweden and Norway would furnish the best possible outlet for the products of these mines, besides opening up a large area of land now practically inaccessible. A few years ago the route was agreed upon and work begun, but partly through lack of funds and partly because of the fear that the road, when completed, might be used by Russia for carrying troops in case of war with the joint kingdoms of Sweden and Norway, no great progress was made. However, the two governments have now taken the matter up and will push the work forward as rapidly as the conditions will permit. Norway has appropriated nearly three million dollars for the construction of that portion which lies in her territory. This will be the shorter end, but more difficulties will be encountered, for on this section there will be thirteen tunnels, two long bridges, and many deep cuts and viaducts. For the Swedish end, the government has made a grant of about eight million dollars. It will have, as now projected, only four tunnels and one bridge of any length.

In general, the engineering problems are neither numerous nor difficult. The plan is to work in the open during the summer and on the tunnels in winter. Some trouble is anticipated from the snow, which in this region is so moist that it packs and quickly freezes so that it becomes solid or else covered with a heavy crust. It is proposed to erect snowsheds over the most exposed portions and to rely upon snowplows for keeping the rest of the track clear.

The gage decided upon is 1·435 meters (4 feet 7 inches), or 10·5 centimeters (3·7 inches) less than the Russian gage, and the rail is to weigh 40 kilogrammes per meter. In driving the tunnels, air drills will be used, but the motive power for compressing the air will be electricity generated by water. It may look like a great waste of energy to transmute power so often, but the idea is that compressed air drills are the best, and that the electric wire is the cheapest way for transmitting energy, and water power is so abundant that large wastes can be tolerated. According to the terms of the contract, the road is to be in running order over the entire distance, 292 kilometers (181 miles), by the first of October, 1902. It will be equipped with new ore cars of the best pattern and turned over to the company owning the mines. They are to pay all the running expenses, keep up repairs, and turn over annually to the two governments a certain per centage on the amounts they expended in building the road. By way of security, the company's stock is held in trust by certain banks, which guarantee payment of the amounts agreed upon.

The western terminus of the road is Victoria Harbor, which is hereafter to be called Ofoten, in order to have a purely Norwegian name and avoid the evidence of any obligation to Sweden for the use of the name of their queen, whom they have in common. When completed, it is expected to ship 1,500,000 tons per annum, and to place it in England for $3.50 per ton. In addition to this saving of 75 cents per ton, the shipment can go on throughout the year, thus giving constant employment instead of the intermittent type of the present day. Even with this enormous output there is no cause for fear that the supply of ore is likely to be soon exhausted. The most cautious and conservative estimates, based upon a thorough examination by means of repeated borings, place the amount of ore within easy reach at 250,000,000 tons.

In mining, the methods pursued will allow work to go on uninterruptedly throughout the year, by working above ground during the open season and in tunnels when the weather is at its worst. The best appliances for hoisting, loading, and unloading are being acquired—most of them coming from the United States—and there is every reason to believe that this road, though entirely north of the Arctic circle, will pay from the very first.

As intimated already, it will open up a section that possesses unexpected possibilities. Just east of the range of mountains that forms the boundary between the two countries there is a large area of land which affords excellent pasturage, and although timber is lacking there are deposits of peat more than sufficient for fuel. When the peat is removed, a very fertile soil is found which, even in the short summer of this latitude, will yield a good crop of hay and even potatoes. At the present time there is only one person to each four square miles, so that with the building of this road a new agricultural or at least grazing district will be available.

This road will have still another beneficial effect. It comes within 67 kilometers (41·5 miles) of the Russian boundary, and Russia, realizing the importance of having a western outlet that is free from ice throughout the year, is taking steps toward building a road through Finland, and is urging Sweden to put in the short connecting link that will place St. Petersburg within 1,100 kilometers (682 miles) of the Atlantic Ocean. The value of such a connection for Russia would be enormous. At the present time, all imported articles there are sold at an increased price, because of the fact that they, brought in during the open season, must lie in stock weeks or months before being sold. The consumers must also pay higher prices because of the inability of the dealers to take advantage of favorable fluctuations in making their purchases. These facts are so forcefully realized that it is safe to predict that by the time the Swedish-Norwegian road is finished the Russian connection will be made, and very soon thereafter one will be able to travel by rail from the Atlantic to the Pacific—from Ofoten to Vladivostok.

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A PASTE with which wall paper can be attached to wood or masonry, adhering to it firmly in spite of dampness, is prepared as usual of rye flour, to which, however, are added, after the boiling, 8⅛ grammes of good linseed oil varnish and 8⅓ grammes of turpentine to every 500 grammes.—Western Painter.

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HOW TO MAKE PAPER FRICTION WHEELS.

BY B. F. FELLS.

The subject of paper friction wheels, which has been discussed to some extent by the technical press, is an interesting one to power users.

I became convinced years ago that, with very few exceptions, a suitable quality of paper stuff would make

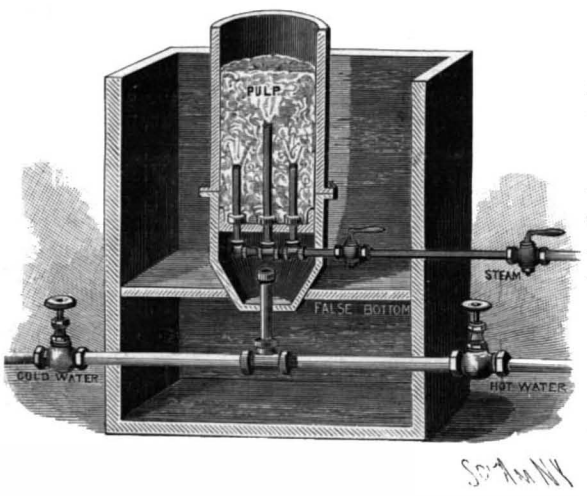

Fig. 1.—PULP MIXER.

a durable friction surface. In my experience with these paper wheels I have always used a special mixture of pulp, seeking to get a combination that was as hard as could be worked to advantage and very fine grained. I accomplished this by using a large percentage of selected stock in the mixture. I procured some high grade unbleached sulphite pulp and used this as a base, adding to it small quantities of vaseline, after which I put the pulp through a special device for further working, a drawing of which is shown.

The apparatus consists of a cast iron central pipe, cone-shaped at the bottom and fastened to the false

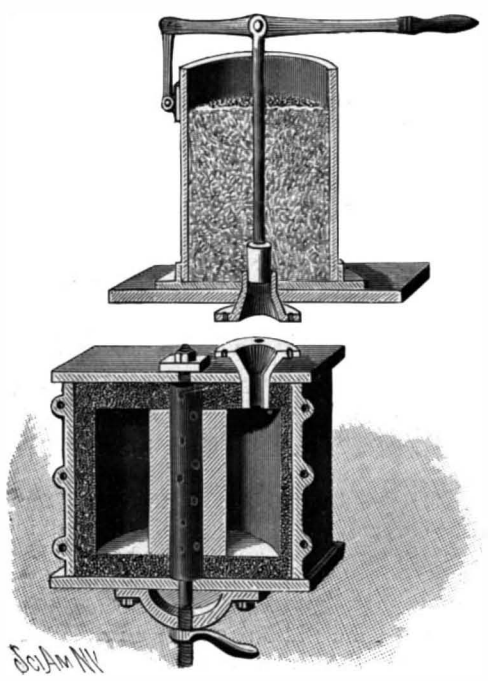

Fig. 2.—SECTION OF MOULD AND MOULD FILLER.

bottom of the pulp tank. The tank is made of wood. Three small pipes are fixed to a center piece vertically and arranged to connect with the steam pipe. The object of these pipes is to distribute steam jets in the mass of pulp and free the fiber. It will be noticed that the upper and lower portions of the pipe are joined by a flanged joint. After steaming and stirring the pulp thoroughly in this pipe, I lift off the upper part, and let the pulp fall to the false bottom of the tank. I then open the hot water valve and let a deluge of hot water come in through the spout which leads into the cone, and overflows to the pulp on the false bottom of

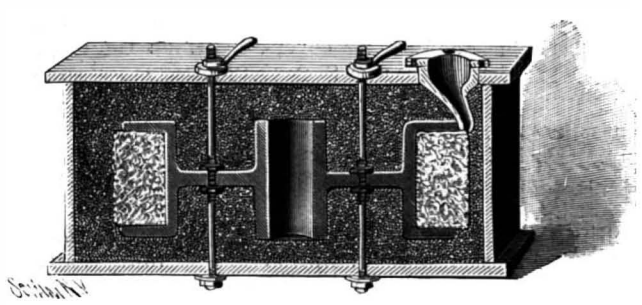

Fig. 3.—MOULD FOR LAGGING IRON WHEEL.

the tank, carrying before it any of the pulp that remained in the lower part of the pipe. Next I rinse off by flowing in cold water in same way. Time for steaming, about 3 hours. For hot water bath I allow 20 minutes, for the cold wash 10 minutes. I now let the pulp lie a few days until it is in good condition for moulding, and then shape it into disks, half disks, quarter disks, and eighth disks, during which operation I add glue. It is a very difficult matter to tell which grade of glue will suit. The so-called waterproof glue consists of glue and carbonate of lime, or glue, zinc white, and alcohol. Glue for preparing most pulp articles is a mixture of glue, "stick," and sulphate of zinc. This kind of glue seemed to me to be the best for the purpose. The illustration, Fig. 2, relate to the casting of the pulp. This figure shows a section of the type of mould used for casting the pulp.

The upper part of Fig. 2 shows a cylindrical cast iron tube with a bottom and a top or lid. The bottom is preferably watertight, and packed and locked with a screw the same as used in curb boxes. The connections to the gate are slip joints packed with a rubber ring, which is slipped into a groove in the end of the sockets which are attached to the outlet. After the device is attached to the gate and filled with pulp, it is only necessary to raise the lever, when the plunger is elevated and the pulp runs through to the mould.

In pouring in this manner, the pulp is taken from the bottom, avoiding the use of pulp which has contracted from the effects of the atmosphere. I have used a mould similar to that shown in cross-section in Fig. 3 for casting a lagging on a wheel. The wheel form is supported on the stubs, and the cope is rammed up with sand with the pouring gate, as indicated.

By this method the pulp is cast on the wheel entire, there being no breaks at joints, as in the divided lagging. Next comes the special operation for rendering the paper wheels suitable for use. In the rough state the surfaces are firm, but lack the necessary properties of a friction wheel when the lagging is dry. Skillful applications of tallow mixtures bring about the desired end, and pure ox tallow may be applied to the wheel face mechanically by the use of the device illustrated in Fig. 4, in which a tank (not shown) contains the melted tallow mixtures which are put upon the surface of the lagging through the brush.

This brush is a hollow metal shell supplied with handles and hog bristles. The tallow ingredients being kept in a liquid state by the steam admitted through the pipe, and the flow being governed by the valve, the operator has only to guide the brush over the surface of the wheel. The latter is revolved rapidly on a shaft. The tallow mixture can be made from pure ox tallow, previously melted and maintained at a temperature of 170° F. Pure ox tallow is effective, but at times more suppleness may be got by adding an ounce of crude wax, three ounces of powdered barytes, and one pound of glue to a fifty pound batch of tallow. The baking or hardening process is best accomplished in a gas-heated oven like that shown in Fig. 5. Here is a plan for making a gas-heated oven consisting of a sheet iron box provided with a perforated false bottom. The gas burners are arranged below this false bottom and are supplied with air and gas through the junction pipe. Stop cocks should be fitted to the piping, so as to govern both the air and gas supply, thus controlling the heat. There are racks upon which to place the wheels to be treated. Ventilation is made by having sub-pipes leading into a main pipe, thus assuring perfect ventilation from the sides. The final finish of the wheels is with linseed oil or crude petroleum, a very little being put on at a time and rubbed in thoroughly until the surface looks like a mirror. To counteract the ill effects of the temperature in damp places the wheel face should be rubbed occasionally with equal parts of linseed oil and turpentine applied with a flannel and then rubbed in with a soft cloth. There is no doubt that paper friction wheels will some day be a part of regular business. In the case of a friction wheel which recently came under my care and which had always been lagged with leather about once in three months, a good paper of strong, close-grained pulp stopped all trouble. It has now been running several months, with but little signs of wear. This wheel is 20 inches diameter and runs 2,000 revolutions per minute.

A New French Telephone.

According to La Vie Scientifique, the French Minister of Commerce has been conducting experiments with a new telephone invented by Pierre Germain, an inspector of telegraphs in Paris. In order to secure patent-rights the inventor has withheld all information regarding the mechanical construction of his telephone. From the little that can be gleaned from the first experiments made, it would seem that the telephone was capable of reproducing sounds with greatly increased phonic power, but with a loss in clearness. In the experiments, the receiver having been brought closer to the ear, not a single intelligible word could be heard: but the greater the distance between the receiver and the ear, the clearer was the sound reproduced. The first defect, it is said, has been remedied. When the experiments were made with this instrument, men and women walking in the streets, although more than 100 yards distant from the receiver, would stop and stare, wondering whence came the voice of superhuman power which they heard above the din of the streets. So powerful is this instrument, that, when used in connection with a phonograph, it is capable of emitting audible sound waves to a distance of nearly 2,000 feet.

Wealth of Labrador.

More is being heard now of Labrador, that land to which legends of giants and curiously deformed men are attached, says The Vancouver News Advertiser. During the last two or three years there has been a growing belief that Labrador, that "great and terrible wilderness," that "Helluland," or region of naked rocks, as the old Norseman called it, is destined to turn out a rich mining region. As yet there is no tangible proof of this; but of late it has been explored in many directions, its rivers have been ascended, its tableland crossed at several points, and the result has been that it has attracted much more attention than before, and is no longer regarded as a desolate heap of rocks, use-

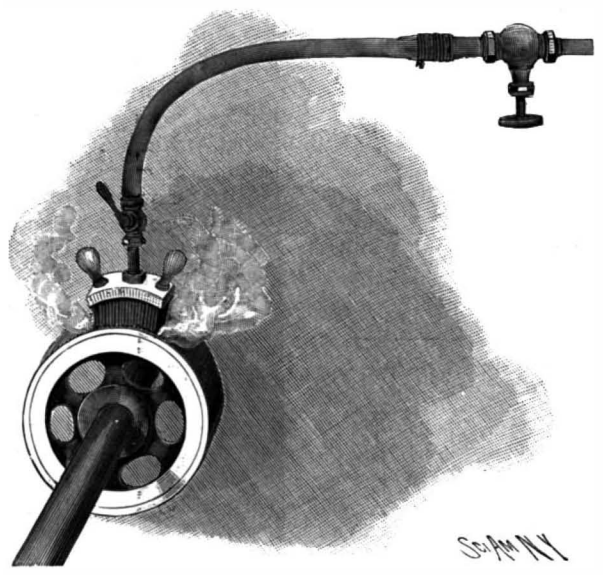

Fig. 4.—FINISHING.

less for the purposes of civilized man. Mr. Lowe has told us of its vast forests, and visitors from various lands have brought back so many specimens of minerals that a widespread impression has arisen that it will become a great mining field.

The magic word gold has been whispered in connection with it, and the possibility of a northeastern Klondike being discovered here has taken possession of the minds of no small number of explorers. Its formations are said to resemble those of the real Klondike, and gold specimens have been found which the keen-eyed hunters of that metal regard as peculiarly promising. The result is that no fewer than seven exploring expeditions have made this year for Labrador. Five of those were organized in Halifax, one left from Boston, and the seventh has just started from St. John's.

In another respect Labrador is attracting attention.

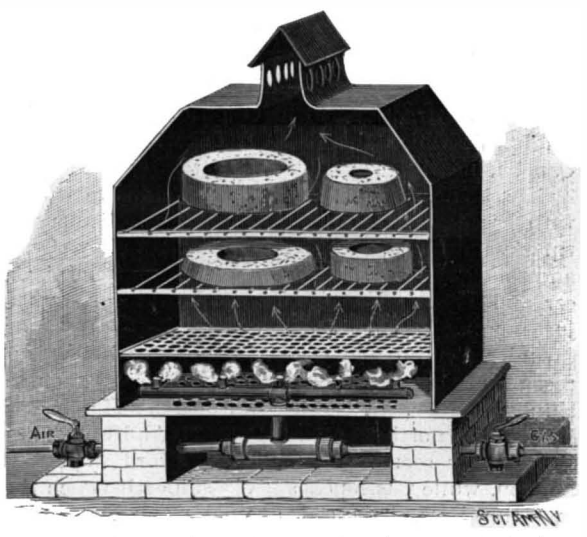

Fig. 5.—DRYING OVEN.

Though the coast is a succession of grim rocks—not without a wild, stern beauty of their own and almost treeless—yet at the heads of some of the bays and inlets there are large areas covered with timber of a large size, mainly spruce, well adapted for lumbering purposes. In these Labrador forests speculation is rife this year. No fewer than twenty-one applications for timber limits, some of them for five hundred square miles, have been made to our government, and the same number of licenses to cut timber have, we understand, been granted, so that a considerable amount of capital is likely to be invested here, and this will furnish increased employment to the people. Labrador hitherto has been famous only for the fish wealth of its seas; now it would seem as if the treasures of the land were to be turned to account. Its dimensions are enormous. The Atlantic coast line is over one thousand miles in length, and the area of the entire peninsula not less than 420,000 square miles.

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A NOVEL CUSHION TIRE.

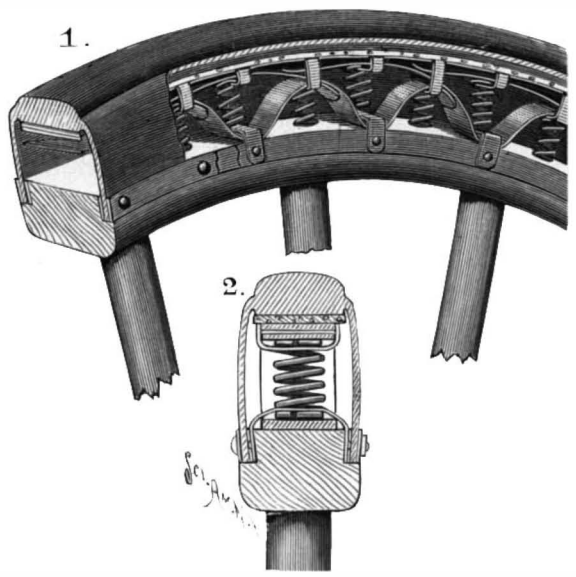
A cushion tire has been invented by O. Ramsey, of El Campo, Tex., which is composed of a series of coiled springs and a series of plate springs, both so arranged between the tread and the rim that they can be easily removed and others substituted, without the necessity of removing the tire from the rim.

Of the accompanying illustrations, Fig. 1 is a perspective view of a wheel-rim, with parts broken away to show the construction of the tire, and Fig. 2 is a cross section of the tire and rim.

On the rim there are secured by straps, a series of plate springs curved to form divergent arms of unequal lengths. The plate springs are so arranged that the outer end of the long arm of one spring shall overlap the outer end of the short arm of the second spring in advance. Two sets of coiled springs are arranged around the rim and disposed in alternate series. One set is secured to the points where the plate springs are bent and fastened to the rim. The other set is secured to the points where the arms of the plate springs overlap.

The tire consists of a covering of rubber thickened at its middle or tread portion, as shown in Fig. 2. Beneath the tread of the tire a strip of cork is secured, which is designed to prevent the moisture, which might possibly penetrate the tread of the tire, from corroding the springs. The edges of the tire are seated in rabbets upon flat packing rings of rubber, likewise designed to prevent the entrance of moisture. To secure the tire to the rim, flat spring-metal bands through which bolts are passed, are employed. The bands are made in sections to permit the removal of any segment, should it become necessary to repair a broken spring.

Tires thus made may be used on bicycles and other vehicles. Should one of the springs become broken, the tire will not collapse, but will still be retained in position by the remaining springs.



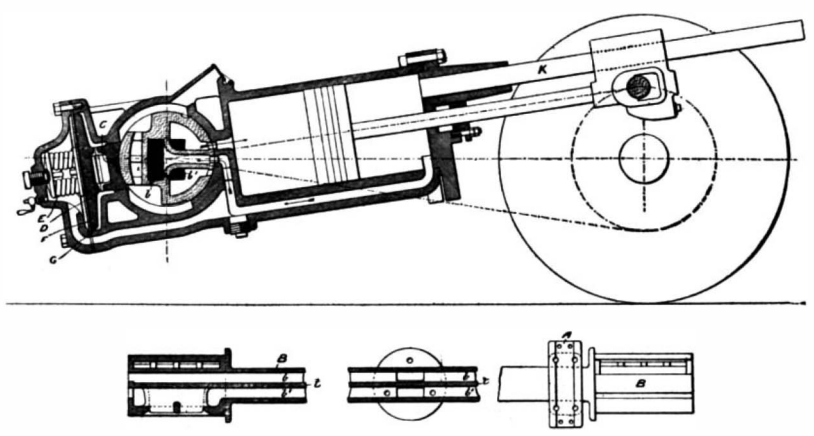
RAMSEY'S CUSHION TIRE.

A LOCOMOTIVE WITH OSCILLATING CYLINDERS.

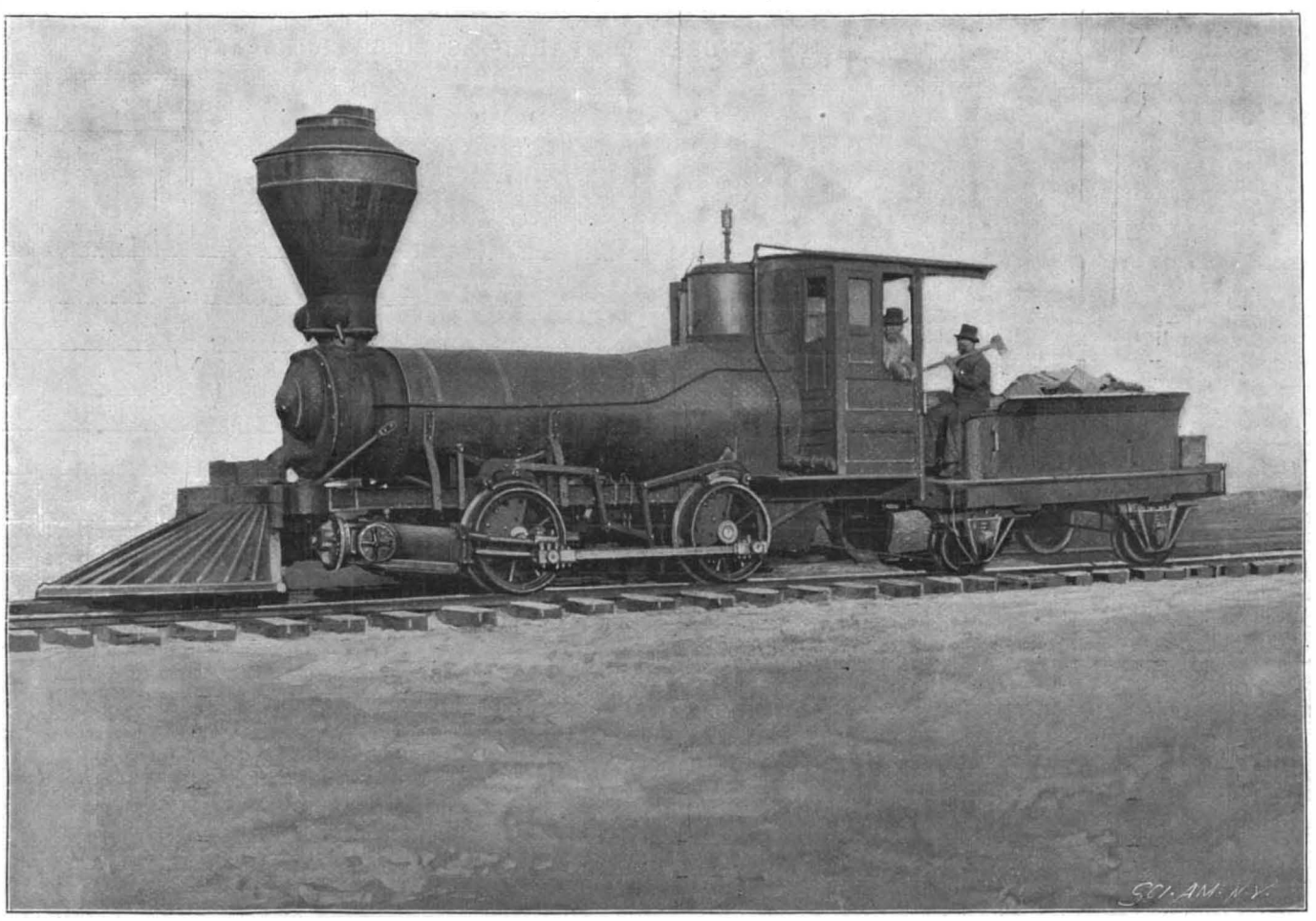
We are indebted to T. W. Garbutt & Company, of Garbutt, Ga., for illustrations of the curious, but serviceable, logging locomotive which is shown in the accompanying engraving. The peculiarity of the engine consists in the use of oscillating cylinders in place of those of the standard type. Although this is not the first time that locomotives have been constructed with oscillating cylinders, we do not know of any other instance where the problem has been worked out with satisfactory results, or where the engine has stood the test of hard service; for we are assured by our correspondent, Mr. A. G. Garbutt, that the engine in question has been doing good work, and has not developed any defects in the trunnions or the moving parts which are peculiar to this type of construction. The details are shown in the accompanying line drawings, from which it will be seen that the cylinders are carried at the ends of a hollow trunnion shaft, which is placed immediately below the smoke box, and bolted to the engine frame at this point. The shaft, which acts as a steam pipe, is divided longitudinally by a diaphragm. Steam is admitted by a two-ported reversing valve at the center of the shaft. The steam ports are formed at the forward end of the cylinder, in the hollow circular steam chest, which forms the bearing on which the cylinder oscillates.

After the cylinder has been placed on the trunnion bearing it is held in place by a circular cap on the side of the cylinder casting. This cap is clearly seen in the halftone engraving of the locomotive. The method of securing steam-tight joints between the trunnion and cylinder casting is very ingenious. At the front of the trunnion and sliding in a recess formed in the cylinder casting is a "quarter-box," *C*, which is normally pressed in close contact with the trunnion by means of a pressure plate, *D*, and stiff spiral springs, *E*, a steam-tight joint being secured by a copper diaphragm, *G*, and rubber packing.

When the cylinder is taking steam at the front end, it is very evident that the pressure has a tendency to push the cylinder forward, bringing it firmly against the trunnion, thus making a steam-tight joint on the backward stroke. When the rear port is open and the cylinder is taking steam from that end, it tends to carry the cylinder to the rear; but the steam when working on this end not only fills the cylinder but also causes a pressure on the pressure plate, which bears on the "quarter-box," *C*, equal to that on the piston. This counteracts the pressure on the piston, and the coil springs already mentioned bring the cylinder forward against the trunnion and thereby make a steam-tight joint on the forward stroke. It will be noticed that the guide bar, *K*, is cast into the cylinder head and that the crosshead is connected directly to the crank pin.



DETAILS OF TRUNNIONS AND CYLINDERS.



LOGGING LOCOMOTIVE WITH OSCILLATING CYLINDERS.

Cylinders, 12 inches by 18 inches; boiler pressure, 140 pounds.

The oscillating type of cylinder was adopted in this case with the object of reducing the number of moving parts and providing a very simple locomotive that could be readily handled by the men in the logging camps. The builders have certainly succeeded in simplifying the ordinary locomotive as far as the multiplicity of parts is concerned, for this little engine has neither eccentric straps, rods, nor links, and indeed the entire link motion of the locomotive is dispensed with, not to mention the main rods.

The brake has proved itself to be simple and effective. It is operated by a 6-inch steam cylinder, bolted to the bottom of the boiler midway between the frame and the driving axles. A ⅝ by 3-inch bar connects the piston of the brake cylinder with levers on both sides of the boiler, as shown in the larger engraving. Wooden brake shoes are used and springs are provided to prevent the lagging of the shoes on the wheel when the brake is not in use. The weight of the locomotive is not given, but the other particulars are as follows: The barrel of the boiler is 40 inches in diameter by 10 feet in length or 13 feet including the firebox. The cylinders are 12 inches in diameter with an 18-inch stroke. The four wheels, all of which are available for adhesion, are 36 inches in diameter, the tires being 8 inches in width. The boiler pressure is 140 pounds per square inch. Owing to the small tank capacity, the engine is limited to runs of from 12 to 15 miles in length, which, however, is sufficient for the purpose of the sawmill. On a level track this locomotive is capable of hauling twenty loaded cars with little difficulty.

The American Sulphur Industry.

About the time of the outbreak of hostilities with Spain, in discussing the sulphur supply of this country, we ventured the prediction that if, under the stimulus of war prices, the known vast deposits of brimstone of the West and South were opened and worked, the industry thus created would not be allowed to perish with the cessation of the war, but would become permanent.

We are pleased to learn that this prediction has been verified to the letter, and a great deal sooner than we anticipated. It is now announced that the owners and workers of sulphur mines opened in California (Humboldt County) and in Utah have found that the deposits can be worked at a profit at peace prices (or those which prevailed prior to the war with Spain), and the mines are now in full blast on this basis.

The United States is thus made independent of Europe, and the rest of the world, in still another commodity, important in peace and indispensable in warfare. With her extension of territory in the tropics, the great markets there opened to her, and the mighty industrial advances thus stimulated, the time must soon come when our country will not need to go beyond her own boundary lines to obtain every necessity and even luxury of life. Whether this condition of independence of all foreign powers, or that of "give and take" hitherto existing, will be the better for us in the long run, is, however, a problem that the future must decide. — The National Druggist.

Absorption of Copper by Trees.

A solution of muriate of copper was taken up by the roots of pines near Santa Fé, says Mr. F. H. Knowlton in The Plant World. This is evidenced, according to Mr. Knowlton, by the fact that when cut, the roots of the pines which were bathed in a weak solution of the muriate yielded an oleoresin of a beautiful emerald hue.

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COMPARATIVE STRENGTH OF THE WORLD'S NAVIES.

The question of the relative strength of the navies of the world, with a particular reference to the standing of the United States, cannot fail to be just now of very vital interest. In the brief three months of the Spanish war, the supreme importance of sea power was brought home to the American people in a series of events the significance of which they have not failed to perceive. A brief sea fight lasting less than half a day, at Manila, and a four hours' running fight at Santiago, brought the close of a war which, had the struggle been decided on land, would have lasted for many months with a prodigal expenditure of blood and treasure.

The world-wide policy to which we are committed by the acquisition of the Philippines and West Indian Islands renders the possession of an adequate navy an immediate and pressing necessity. In the present article we have endeavored to determine exactly where we stand at the close of the year 1898, and while there is cause for congratulation on our improved position compared with our practical extinction as a naval power a decade and a half ago, we must bear in mind that our improved standing brings with it added responsibilities, for which our present naval strength is quite inadequate. At present we are fourth on the list, having recently passed the Italian and German fleets in total displacement. If the new programme proposed by the Naval Board is accepted by Congress, the total displacement of our navy will be about what that of Russia is now. Russia, however, is actively engaged on new construction, and we must continue to add liberally to our navy if we are to take the third position—a ranking which would be more appropriate to our wealth and the extent and responsibilities of our foreign possessions.

BASIS OF COMPARISON.—The difficulty of making a satisfactory comparison of naval strength is proved by the many different systems of comparison adopted. Some of these are obviously misleading, as when the mere number of ships is taken, or the aggregate number of guns, or the speed, or the thickness of armor. The value of a navy is not to be determined by any one of these features alone. A ship of a limited size can only embody a certain amount of the elements of fighting efficiency. She may carry an unusually heavy battery and thick armor, but it will be done at the expense of the speed or the coal endurance, as in the case of the "Indiana" or "Massachusetts." Again, a vessel may be extraordinarily fast, and capable of steaming around the world without recoaling, like our "Minneapolis" and "Columbia," but her speed and endurance will be gained at the expense of armor and armament.

We cannot expect to get "a quart of efficiency out of a pint of displacement."

The science of naval designing consists in securing such an apportioning of the total displacement of a ship to the different elements of efficiency as shall best meet the requirements of the nation in whose service she is to be employed. The fact that there is a considerable difference in the service required of their ships by the various nations, differences due to geographical position and general foreign policy, renders it difficult to institute any hard and fast comparison between the various navies of the world, and the best that can be done is to compare them as to their actual fighting value on a basis of displacement and age.

Such a comparison is more satisfactory than any other that can be adopted, for the principles of warship design are so well understood, and the leading naval architects are so thoroughly in touch with each other's work and the contemporaneous improvements in material, that we think it is likely that a thousand tons of displacement in a battleship of a certain date is worth about as much as a thousand tons in another battleship of the same date, even though the ships

TABLE I.—NAVIES OF THE WORLD COMPARED BY DISPLACEMENT.

Description of Type.	GREAT BRITAIN.				FRANCE.				RUSSIA.				UNITED STATES.				GERMANY.				ITALY.			
	Number of Ships.	Average Displacement.	Total Displacement.	Average Speed.	Number of Ships.	Average Displacement.	Total Displacement.	Average Speed.	Number of Ships.	Average Displacement.	Total Displacement.	Average Speed.	Number of Ships.	Average Displacement.	Total Displacement.	Average Speed.	Number of Ships.	Average Displacement.	Total Displacement.	Average Speed.	Number of Ships.	Average Displacement.	Total Displacement.	Average Speed.
Battleships, 10 years or less.	34	14,008	476,272	18·0	14	11,457	160,398	17·5	17	11,200	190,400	17·7	13	11,010	143,130	16·7	9	10,672	96,048	17·3	8	12,336	98,688	19·3
Battleships, 10 to 20 years.	11	9,474	104,214	16·1	9	10,143	91,289	15·6	5	10,120	50,600	16·0	....	....	....	..	....	....	....	..	7	12,018	84,126	16 7
Battleships, Old or refitted.	9	8,872	79,848	14 1	12	7,482	89,784	13·6	1	....	9,891	14·5	...	....	....	..	10	7,211	72,110	14·1	....	....	....	..
Totals	54		660,334	..	35	..	341,471	..	23	....	250,891	..	13	....	143,130	..	19	....	168,158	..	15	.	182,814	..
Coast Defense Vessels.	25	6,284	157,100	11·8	14	3,637	50,920	14	14	2,915	40,810	13·0	11	3,551	40,261	12·2	19	2,081	39,539	12·6	....	....	....	..
Armored Cruisers, 9,000 tons and up.	8	13,500	108,000	22·0	7	9,767	68,369	21·3	4	11,846	47,384	20·0	1	....	9,215	21·9	1	10,650	10,650	19·0	....	....	....	..
Armored Cruisers, 7,000 to 9,000 tons.	2	8,400	16,800	17·4	3	7,700	23,100	21·0	1	....	8,524	16·7	1	....	8,200	21·0	....	....	....	..	....	....	....	.
Armored Cruisers, Below 7.000 tons.	7	5,600	39,200	18·0	10	5,578	55,780	17·0	6	5,754	34,524	15·6	....	....	....	..	...	....	....	..	5	6,347	31,735	19·8
Totals	17	..	164,000	..	20	..	147,249	..	11	....	90,432	..	2	....	17,415	..	1	....	10,650	..	5	.	31,735	.
Protected Cruisers 10,000 tons and up.	10	11,640	116,400	20·8	..	..	..	..	....	....	....	..	....	....	....	..	....	. ..	....	..	....	....	....	..
Protected Cruisers 7,000 to 10,000 tons	11	7,780	85,550	20·2	4	8,014	32,056	21·0	....	....	...	..	2	7,375	14,750	22 9	....	....	....	..	....	....	....	..
Protected Cruisers 4,000 to 7,000 tons.	30	5,000	150,000	19·0	13	4,833	62,829	18·9	4	6,222	24,888	19·4	6	4,539	27,234	19·6	9	5,315	47,835	20·1	.. .	....	....	..
Cruisers, 2,000 to 4,000 tons.	46	2,924	134,510	19·5	20	2,978	59,560	18·7	2	3,439	6,878	18·6	11	2,974	32,710	18·4	3	2,225	6,675	21·25	17	2,754	46,818	18·0
Totals	97	..	486,460	..	37	..	154,445	..	6	....	31,766	.	19	....	74,694	.	12	....	54,510	..	17	....	46,818	18·0
Small Cruisers and Gunboats.	97	924	89,628	15·2	38	988	37,544	17·1	32	1,250	40,000	16·6	22	1,237	27,210	16·0	22	1,205	26,510	16·0	28	886	24,808	17·9
Grand Totals	290	..	1,557,522	..	144	..	731,629	..	86	....	453,899	..	67	....	303,070	..	73	....	299,637	..	65	....	286 175	..

TABLE II.—NAVIES OF THE WORLD COMPARED AS TO EFFICIENCY.

Description of Type.	GREAT BRITAIN.			FRANCE.			RUSSIA.			UNITED STATES.			GERMANY.			ITALY.		
	Displacement.	Factor of efficiency.	Estimated efficiency by displacement.	Displacement.	Factor of efficiency.	Estimated efficiency by displacement.	Displacement.	Factor of efficiency.	Estimated efficiency by displacement.	Displacement.	Factor of efficiency.	Estimated efficiency by displacement.	Displacement.	Factor of efficiency.	Estimated efficiency by displacement.	Displacement.	Factor of efficiency.	Estimated efficiency by displacement.
Battleships 10 years or less.	476,272	1·00	476,272	160,398	1·00	160,398	190,400	1·00	190,400	143,130	1·00	143,130	96,048	1·00	96,048	98,688	1·00	98,688
Battleships, 10 to 20 years.	104,214	0·80	83,371	92,289	0 75	68,467	60,600	0·85	43,010	....	..	....	....	..	....	84,126	0 80	67,301
Battleships, Old or refitted.	79,818	0·50	39,924	89,784	0 45	40,403	9,891	0·65	6,429	....	..	....	72,110	0·60	43.266	....	..	....
Totals	660.334		599.567	341.471	..	259.337	250,891	..	239.839	143 130	..	143,130	168.158	..	139.314	182.814	..	165.988
Coast Defense Vessels.	157,100	0 40	62.840	50.920	0·70	44.912	40,810	0·70	28,567	40,261	0·65	26,170	39.539	0·60	23,788	....	..	....
Armored Cruisers, 9,000 tons and up.	108,000	0·85	91,800	68,369	0·85	58,114	47,384	0·85	40,276	9,215	0·85	7,833	10,650	0·85	9,052	....	..	....
Armored Cruisers, 7,000 to 9,000 tons.	16,800	0·80	13,440	23,100	0·85	19,635	8,524	0·80	6,819	8,200	0·85	6,970	....	..	....	....	..	....
Armored Cruisers, Below 7,000 tons.	39,200	0·75	29,400	55,780	0·70	39,046	34,524	0·75	25,893	....	..	...	....	..	....	31,735	0·90	28,561
Totals	164,000	..	134,640	147,249	..	115.794	90,432	..	72.978	17,415	..	14.803	10.650	..	9.052	31,735	..	28,561
Protected Cruisers 10,000 tons and up.	116,400	0·85	98,940	....	..	....	....	..	....	....	..	....	....	..	....	....	.	....
Protected Cruisers 7,000 to 10,000 tons	85,550	0·80	68,440	32,056	0 80	25,645	....	..	....	14,750	0·80	11,800	. ..	..	....	....	..	....
Protected Cruisers 4,000 to 7,000 tons.	150,000	0·75	112,500	62,829	0·75	47,122	24,888	0 75	18,666	27,234	0·75	20,425	47.835	0·75	35,876	....	..	....
Cruisers, 2,000 to 4,000 tons.	134,510	0·70	94,157	59,560	0·70	41,692	6,878	0·70	4,815	32,710	0·70	22,897	6,675	0·75	5,006	46,818	0·70	32,773
Totals	486,460	..	374,037	154.445	..	114.457	31.766	..	24.168	74,694	..	55.122	54,510	..	40.682	46.818	..	32.773
Small Cruisers and Gunboats.	89,628	0·40	35,851	37 544	0·45	16,895	40,000	0·45	18,000	27,210	0·45	12,245	26,510	0 45	11,930	24,808	0·45	11,164
Grand Totals	1,557,522	..	1,206,935	731 629	..	551,395	453 899	..	383 552	303 070	..	251,470	299,637	..	224 766	286,175	..	238,485

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differ greatly in design. This statement of course does not apply to vessels in which glaring defects of design and workmanship are known to exist; but, as a general rule, it may be safely followed.

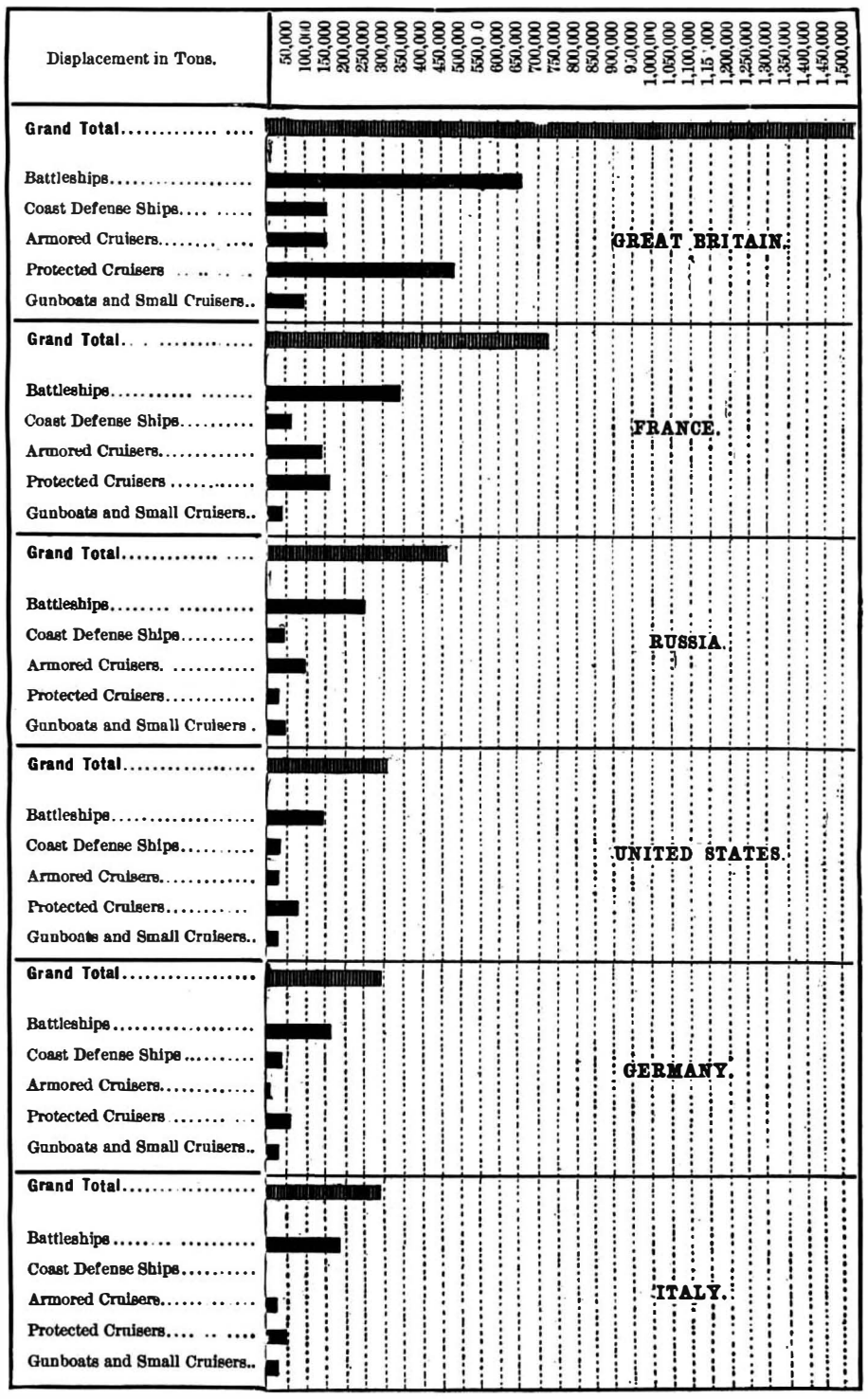
There are some builders of warships who are notorious for turning out vessels of a sensational character, in which what might be called the showy and spectacular features, such as great speed and exaggerated batteries, are emphasized at the cost of other less attractive features, such as coal capacity and ammunition supply. The most notorious example of this is to be found in the celebrated Armstrong firm, whose vessels are the fastest and most powerfully armed in the world. It is safe to say that the speed and battery power of these ships are secured at the cost of other elements of efficiency, and that a thousand tons in an Armstrong vessel does not represent so much more fighting efficiency than a thousand tons in other contemporaneous vessels turned out from any of the best shipbuilding yards of the world.

It must be admitted at the outset that, in spite of the fact that three modern naval engagements have been fought, the battles of the Yalu, Manila, and Santiago, we are yet very much in the dark as to the relative values of speed, guns, armor, ammunition, and coal. If any one knew, to a certainty, that a protected cruiser like the "Esmeralda," that is crammed with guns, could rush in and sink, in the first few minutes of a fight, an armored cruiser like the "Dupuy de Lome," which is clothed from stem to stern and from upper deck to water line with armor, our estimate based on displacement would count for very little—but no one does know that guns are absolutely supreme. At Santiago not a belt or a barbette was penetrated, and the stoutest shield that was pierced was not over two inches in thickness.

Until a contest between nations of equal strength and skill has taken place, and a thousand-and-one vexed questions have been determined, the only satisfactory basis of comparison will be that of displacement, qualified by the age of the particular ships under consideration.

We show the relative strength of the navies of the world by three graphic comparisons and two tabular analyses. In the front page cuts the size of the navies is indicated by the respective bulk of the vessels shown. Each navy is represented by a typical first-class battleship. The vessels are as follows: England, the "Royal Sovereign;" France, the "Jauréguiberry;" Russia, the "Sissoi Veliky;" United States, the "Iowa;" Germany, the "Brandenburg;" Italy, the "Sardegna." The drawings, as will be seen, have been made with great care and attention to detail, with the object of showing at a glance not only the relative size of the navies, but the types of vessels to which is intrusted the duty of forming the first line of defense.

In the first of the two tables the ships are arranged in five classes, according as they are battleships, coast defense vessels, armored cruisers, protected cruisers, and small cruisers and gunboats. We have taken no account of the torpedo fleets, for the reason that they are such an uncertain quantity that no exact value can be put upon them in a comparison such as this; moreover, it is extremely unlikely that the torpedo fleets will take any part in pitched battles upon the high seas. The fate of the "Furor" and "Pluton" at Santiago will certainly not encourage the use of these craft in the open sea and in broad daylight. If the torpedo fleets were to be considered, it would strengthen Great Britain's position, because of the number, size, and seaworthiness of her destroyers.



The data regarding the vessels in each class includes the number of ships, average displacement, total displacement, and speed.

Two different systems of classification have been adopted for the battleships and the cruisers, the former being graded according to their age (the latest ships being, of course, the best) and the cruisers according to their size. There is a much greater disparity in the age and, therefore, in the efficiency of the battleships than in the cruisers. The former have been built at various times during a period of thirty years, whereas the great fleets of cruisers, particularly in the larger classes, are much more modern, nearly all of them having been built during the past ten or fifteen years. Hence in the battleships their age is a very safe indication of their efficiency, especially when, as in our tables, their speed and average displacement is stated. The cruisers, on the other hand, being nearly all of modern construction, can best be rated according to their size, for it will be noted that the size is accompanied with high speed, and, as a matter of fact, the largest cruisers are in every case of late construction.

The tables include all those ships which, as far as we have been able to learn, will be actually under construction by January 1, 1899. No account is taken of the ships authorized under ten year programmes of construction, but not yet laid down.

It will be noticed that the total number of vessels is not equal to that shown in the official lists, notably in the case of Great Britain and the United States. This is due to the fact that we have imposed a limit, either of age or speed, in making up the tables. Thus, under the head "Battleships, old or refitted," none are included that are over twenty-five years old, while from the coast defense class are excluded all vessels of less than 10 knots speed. No vessels included in the armored and protected cruiser classes have a speed of less than 15 knots, and none in the small cruiser and gunboat class have a speed of less than 12 knots. The result is that our tables show the available fighting strength with a closeness which we think has never been attempted in any similar tabulation.

But, while the displacement basis gives us a fair estimate of the strength of navy as compared with navy, class by class, it does not afford a true comparison of the relative strength of the classes in any individual navy. So many thousand tons in battleships (so to speak) is worth more than the same number of tons in cruisers and considerably more than the same amount in gunboats. So also there is a variation in the displacement value due to the age of the boats and to other features which do not appear in our first table.

In order to rectify this disparity and reduce the displacement of the various classes "to common terms," as it were, we have multiplied the totals by a scale of factors of efficiency, the battleships standing at par value and the other types having decreasing values, descending to as low as 0·40 for the British coast defense vessels and gunboats. It will be noticed that the armored cruisers are valued in the British and Italian navies above the ten year old battleships, it being considered that their high speed, coal endurance, and modern armor more than outweigh the heavy batteries of the battleships. The Russian coast defense vessels, being of modern construction, with high power guns and good speed, are rated at 0·70 as against 0·40 for the older British ships, many of which carry muzzle-loading guns.

The percentage basis affects the United States favorably; that is to say, it brings out the fact that our battleships are all modern, as against the German and Italian battleships, nearly one-half of which were built from ten to twenty years ago. While the factor of efficiency adopted is purely arbitrary, it undoubtedly gives results which are more truly representative than those contained in the first table.

It will be noticed that Great Britain easily more than maintains the position which she has set for herself, of being equal in power to the next two strongest navies, those of France and Russia; and the fact that we have moved up into the fourth place with (as the efficiency table shows) a substantial lead over Germany and Italy, will be a pleasant surprise, and highly gratifying to all those who are interested (and who is not?) in the growth of our naval power.

THE equipment of the army, in the late war, is reported upon by Quartermaster-General M. I. Ludington. In three and a half months an army of 275,000 men was uniformed, armed, and equipped with supplies and an army of 16,000 men was sent to Cuba. In the war period the animals purchased cost $3,871,690; wagons and harness cost $358,449, and 83,078 tons of coal were purchased. The movement of troops by rail aggregated 17,863 officers and 435,569 men. The department chartered on the Atlantic coast, to June 30, 43 vessels with a total of 104,201 tons, and these had a carrying capacity of 1,287 officers, 22,335 men, 6,746 animals, and the arms, ammunition, and camp subsistence and medical supplies; four water-boats, of a total capacity of 820,000 gallons, tugs, and barges were added to this fleet. On the Pacific coast 14 ships were chartered, aggregating 41,152 tons, capable of carrying 629 officers and 13,059 men and their stores. These vessels cost $186,632 for fitting up; and there was paid for the service of these ships $1,007,952 on the Atlantic side and $319,764 on the Pacific side. After June 30, other vessels were chartered or purchased, increasing the total tonnage to 111,099 tons, and the carrying capacity to 25,000 men on the Atlantic, and to 61,287 tons and 20,000 men on the Pacific. Fourteen ships, aggregating 61,298 tons, were purchased for $5,431,000; including other vessels and lighters bought, the aggregate expenditure on this account was $6,476,300.

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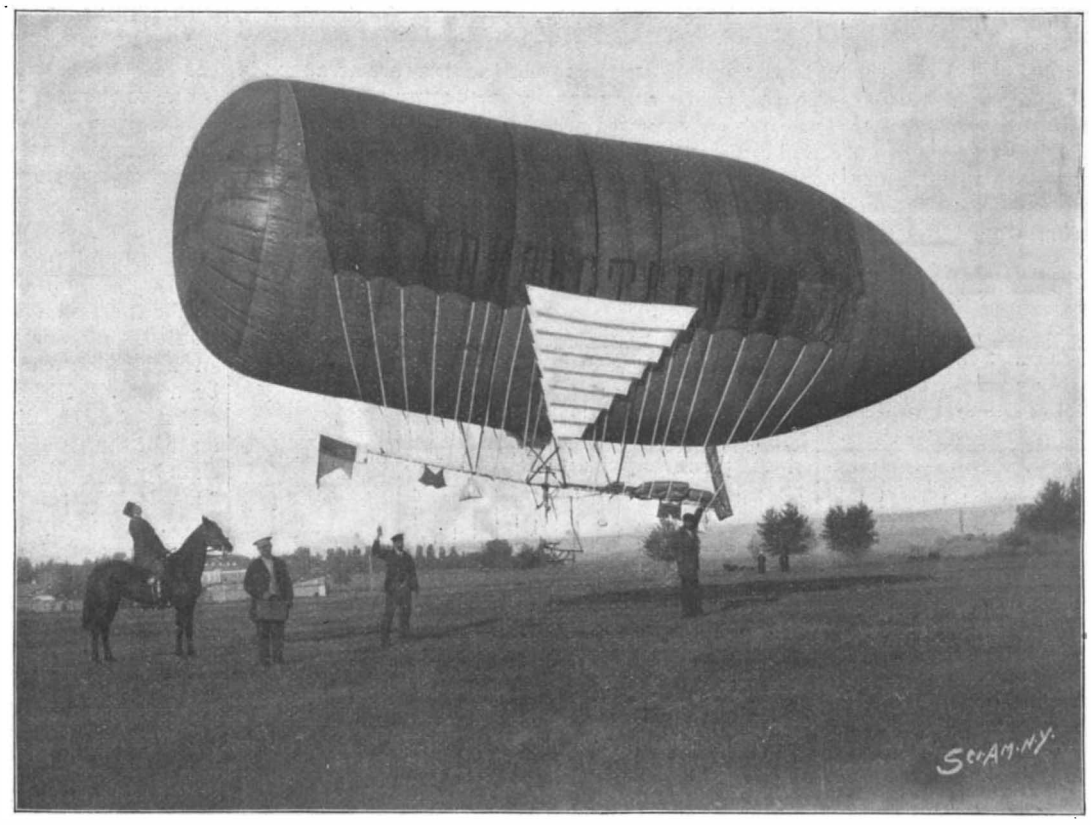
THE DANILEWSKY DIRIGIBLE FLYING MACHINE.

We have been favored by Dr. K. I. Danilewsky, of Charkov, Russia, with some photographs of his dirigible flying machine and notes of various experiments.

This balloon-flying machine is based on the hypothesis that if a man's strength, in proportion to his weight, is not sufficient to raise him in the air, he can raise himself if part of his weight is subtracted. By the use of a balloon filled with hydrogen the weight of the man is eliminated from the problem, and he can use all his efforts to propel and steer the balloon which supports him. Our engravings, which are made from direct photographs of the balloon in mid-air, show the relative size and form of the great wings, which are 16 feet long. In order to utilize the whole power of the wings for progressive movement, it is necessary to rise high in the air, and then the wings can be placed at 90° without any risk of descending. In the latter case, to keep the machine from descending, it is better to open the parachute. On October 8, 1897, some 25 ascents were made in an hour and a half. Other ascents were made in the spring and summer of 1898 with good success, the balloon being turned round and round repeatedly. The size of the wings was decreased to 11⅔ feet and the working surface was increased. At a height of 280 feet the balloon was kept immovable and was turned around in the air several times. It was found that the balloon must be inflated with fresh hydrogen every seven or eight days.

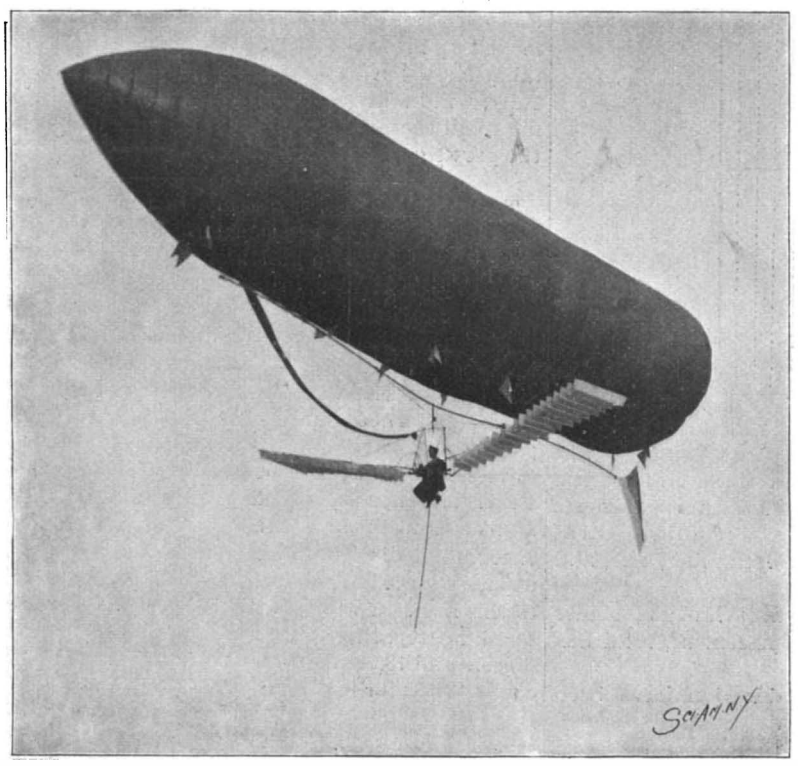


DANILEWSKY'S DIRIGIBLE FLYING MACHINE, SHOWING WINGS.

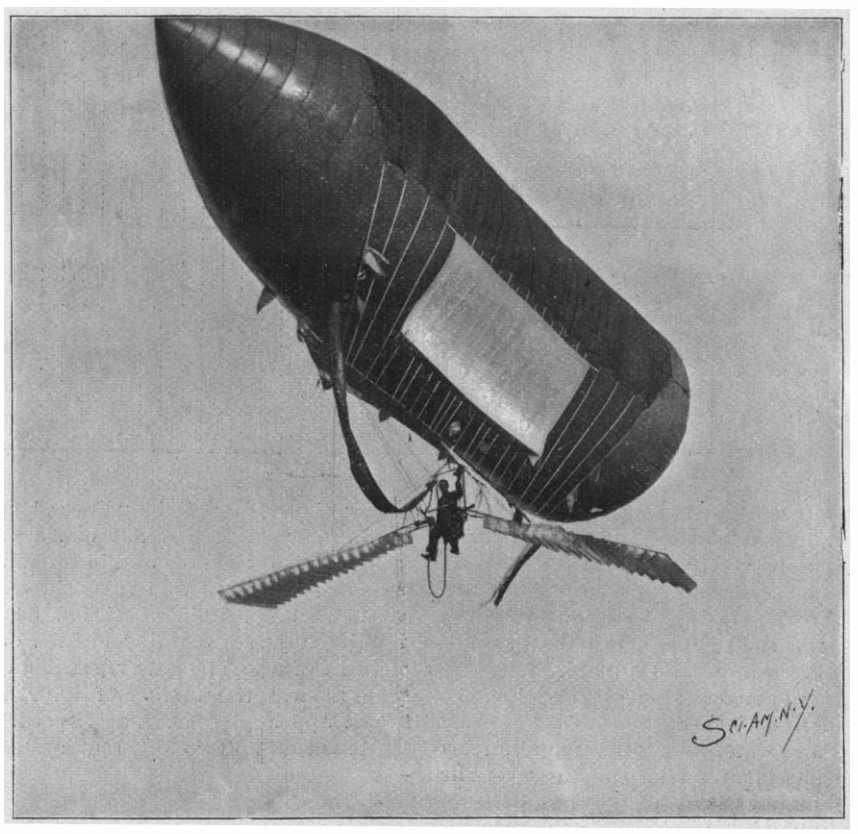
While such experiments do not solve the problem of a really practical flying machine, which can go for miles without descending and can be managed at will, still they show that inventors are on the right track, and our government has done wisely in appropriating $25,000 for experiments on the subject under the direction of competent scientists who will guard against the wasting of money on the exploitation of freak devices.

Are Birds Affected by Eating Poisonous Food?

There is a great difference of opinion on this subject. While some maintain birds do not eat fruit which is poisonous, others hold they eat only the surrounding pulp, as the berries of taxus, which is perfectly harmless, whereas the seed is very poisonous. Others, again, have maintained that they do not eat sufficient to be poisoned. A recent number of Nature contained an interesting letter on this subject in which the views of a number of writers are presented. The correspondent of this journal states that he believes the birds eat largely of these berries, both the pulp and seed, and they very shortly afterward eject the seeds and skins by the mouth, thus avoiding the poisonous substance. He states that where a number of thrushes fed on the berries of Pyrus aucuparia, for at least a square mile of ground every patch of grass was covered with the ejected seeds and skins of these berries, all of the pulp having disappeared, while the skins were as bright and fresh as when they were swallowed, showing they could not have passed through the alimentary canal. Each of the pellets was flat and round and about the size of a ten cent piece. The birds were constantly flying to and fro between the adjoining woods and the park. Excessive drought, by decreasing the supply of their ordinary food, was evidently the cause of their taking the berries at such an early period as September. The next bit of evidence which the correspondent obtained was when he discovered a number of similar pellets consisting entirely of seeds and skins of yew berries, the former being a bright green and the latter as scarlet as when they were on the tree. In one of these pellets he counted twenty or more seeds. The real difficulty in accepting this explanation is that, so far as we know, no one has actually seen the birds eject the seeds. Two friends of his came very near seeing the accomplishment of this process. A thrush was seated under a yew tree going through violent contortions, its wings drooping on the ground. They thought it was ill, but it flew away strongly as if nothing was the matter. Another correspondent of Nature saw thrushes feeding freely on the berries of the Daphne mezereon, an undoubted poisonous plant. In this instance there is little question that they ejected the seeds. He said they were so stupefied that they apparently might be taken with the hand. Another writer found that pheasants were killed by eating the leaves of the yew tree, and similar instances have been recorded. Everyone is familiar with the manner in which owls disgorge the fur and bones of mice and the skulls of small birds—a habit which is shared by all the raptorial birds. The habit of ejecting the indigestible and poisonous parts of foods by birds is an interesting subject for observation and experiment. Possibly some of our readers may have noted instances of the same kind.



THE WINGS RAISED IN MIDAIR.



WINGS DEPRESSED.

Education of Electric Motor Cabmen.

The use of electric carriages is greatly increasing in Paris, where they now ply regularly for hire. The company has secured a tract of land out in the country and would-be motormen are required to travel up and down this tract of land until they are proficient in the management of the electrical vehicles. The road at different places is constructed of different material, as asphalt, macadam, wood, and stone. Various obstructions are put in the way, such as baby carriages, pedestrians, bicycles, etc. These are made of thin boards and are painted to represent the various objects. They are held in place by a stay or prop, and the motorman is required to circulate around them until he becomes proficient in managing his vehicle. This is an excellent idea, and it is to be hoped the same thing will be in use here when the horseless vehicle comes into more general use. Notwithstanding the fact there are many electrical vehicles plying in the city of New York, there have been few if any accidents by them, which shows that our drivers are at least as careful as their French brethren. In the recent severe storm in New York electric carriages succeeded in getting along rapidly when the ordinary cab could only proceed at a snail's pace, which may be regarded as a genuine victory for the electric carriage.

To Our Subscribers.

The present issue of the SCIENTIFIC AMERICAN is the fifty-third number of the year, so that our subscribers really receive an extra copy gratis. With this issue doubtless many subscriptions will expire, and we request such of our readers as have not already done so to remit at once, so that there will be no break in their receipt of the SCIENTIFIC AMERICAN. We cease sending the paper immediately on expiration of the subscription, as we feel that this is fairer than to continue sending the paper and collecting for it at a subsequent time, as is done by many periodicals. We shall be glad to send a sample copy of our SUPPLEMENT to any of our readers who may not be familiar with it, and our combined rate for the two papers places the SUPPLEMENT, the most valuable paper of its kind in the world, within the reach of all.

SWEDISH doctors have no fixed charge for their services. Patients are expected to pay in proportion to their ability.

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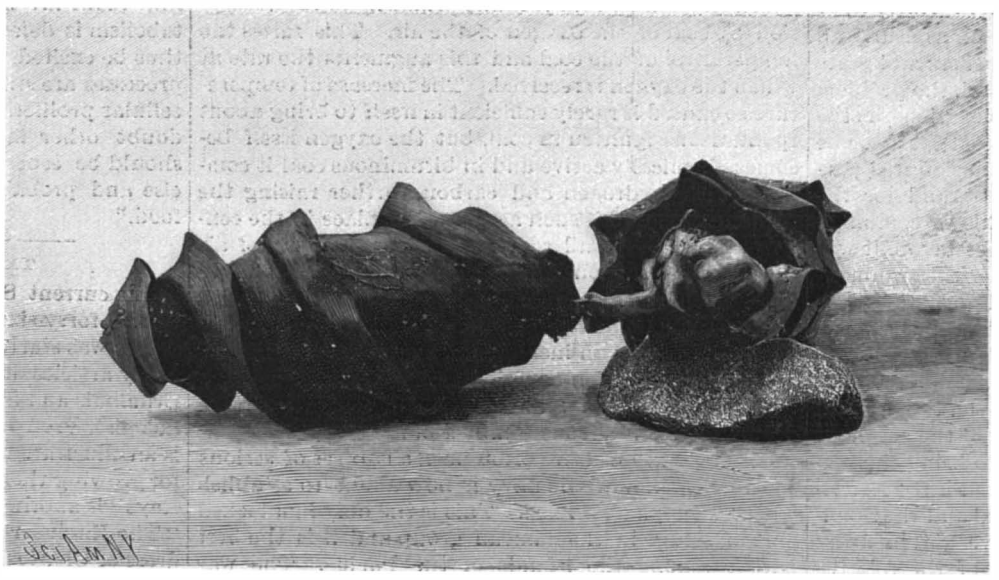
MIMICRY IN THE EGGS OF FISHES.

BY CHARLES F. HOLDER.

The study of the protective resemblances among animals is a field of no little interest, well illustrating the marvelous devices of Nature for the protection and perpetuation of life.

This is well shown in the eggs of fishes, which seem, in some instances, to be almost endowed with a special sense, enabling them to avoid their enemies and reach the seclusion necessary to their safety.

The accomplishment of this is attained by a remarkable imitation on the part of the egg, or egg-case, to plants of their various parts. An interesting, indeed striking, example of this is seen in the accompanying illustration, which shows the egg-case of a peculiar shark and an egg-case broken, the young shark being in the act of escaping. The shark which produces the egg is a member of the Castracionidæ; about twenty-five genera being known, of which twenty-two possess a special interest to geologists as having lived previous to the oolite. But a few years ago the fish was only known by fossil forms, but finally a living specimen was caught at Port Jackson, Australia, showing that this "ancient and fish-like form" had endured until to-day. Another specimen was soon discovered in the waters of California and described as Gyropleurodus francisci, the singular shark whose egg-case is figured. It is a small fish, rarely over three feet in length, beautifully marked, having a horny spine in front of each dorsal fin.



EGG OF THE SHARK, SHOWING THE YOUNG EMERGING.

The shark is a sluggish creature, often seen lying asleep or dormant in crevices in the rocks, and occasionally caught in seines.

The eggs are deposited in a black or dark case which takes the form of a perfect spiral, and looks exactly like a leaf of kelp or weed folded up, imitating the weed not only in form and shape, but in color. This is deposited by the shark amid the kelp beds, where it clings to the leaves by the edges of the spirals, and is thus prevented from washing ashore. A more perfect mimicry it would be impossible to imagine. When the young shark attains its maximum size within the egg, it bursts open or forces the end of the pseudo leaf and swims away to become the victim in many cases of predatory fishes. Another shark on the Pacific coast has an equally remarkable egg. It is dark, barrow-shaped, with four long tentacle like handles which grasp the surrounding weed, and cling to it; not merely preventing the egg from floating ashore, but presenting a perfect case of mimicry, the egg resembling a leaf so perfectly that it is often passed by by the closest observer.

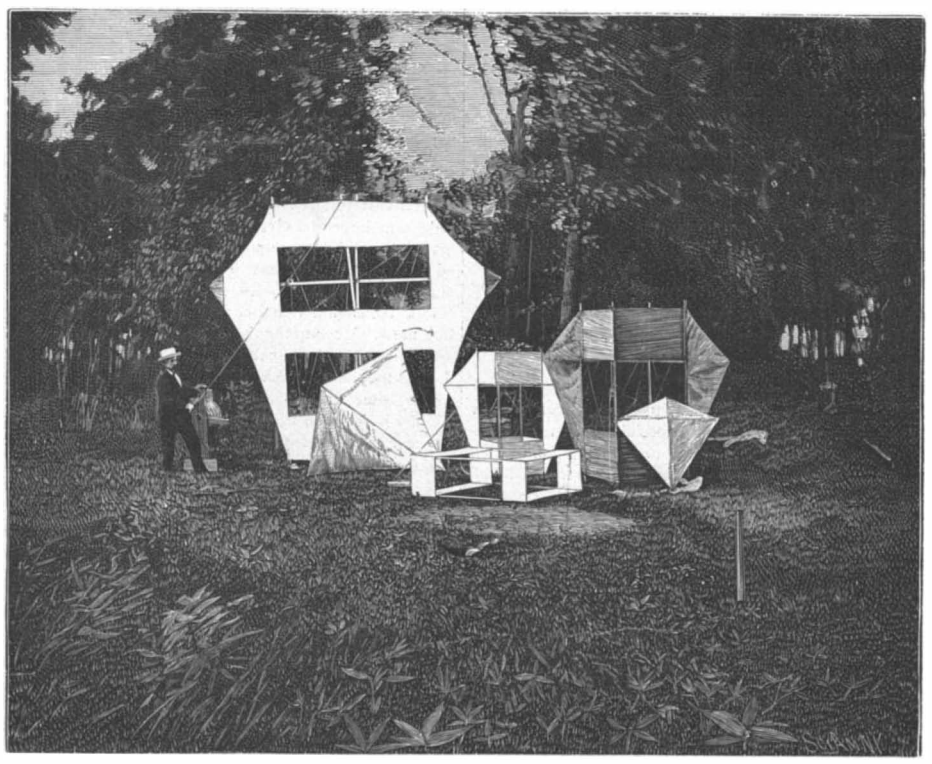
Many of the eggs of fishes are almost invisible, and float upon the surface. Those of the remarkable fish Antennarius dot the leaves of the kelp, minute white balls, which are taken by the novice as some interesting lime-secreting animal. The long, grape-like, conspicuous eggs of the hag fish are found among the kelp in certain localities and bear a remarkable resemblance to the floats of the weed, and in this manner escape detection. Many of the egg-cases of sharks illustrate the efforts of Nature to protect her own. Some are adorned with barbels that resemble the small leaves of the sea weed in which they are deposited, and all have the exact tint and color of the objects about them.

SCIENTIFIC KITE FLYING.

For several years past, the making and flying of kites upon scientific principles has been recognized by many amateurs. We have already on several occasions illustrated the Eddy kites and the experiments of Lieutenant Wise and Mr. Hargraves are also well known. Both the Eddy kite and the box kite have great efficiency, but Mr. Warren H. Smith, of Pontiac, Mich., writes us that he has devised a square box kite which is superior to either. Mr. Smith's box kite has the flying bridle on one corner and has its flying surface greatly increased by a pair of fixed triangular wings, thus making the entire width somewhat greater than the height of the frame. The first kite of this sort was only 30 inches high and 38 inches wide, with the wing piece bent back to a depth of bow equal to one-tenth of its length, the wings presenting a convex surface to the air. The covering was light paper and the frame cover weighed but a few ounces. Experiments showed that even this small kite had good points for either single or tandem flying. Flown in tandem with two moderate sized Eddy kites at an elevation of 1,500 feet, the main line was carried up at an average angle of forty-five degrees, and sometimes as much as seventy degrees. This kite was, of course, too frail for anything but a gentle breeze.

The next kite was built of solid wood sticks, and the cells were covered with manila paper, and the wings had a spread of 4 feet. This kite weighed one pound and did fully as well as the first. It presented 12 feet of flying surface and had a pull varying from 3 to 6 pounds in a moderate wind. Later in the season kites 4, 5, and 6 feet in height were built, and they were covered with paper or cambric, cloth being more suitable for high velocity. The largest two-cell kite was 7 feet high, and weighed 6 pounds. This kite was flown many times singly, and in tandem with lighter ones. In a breeze blowing 12 to 15 miles an hour, the tension was from 20 to 30 pounds. The last kite of the season measured 14 feet from wing to wing.

There were three cells, one at the top, one at the bottom and one midway between the other two, each cell being covered with a strip of cambric two feet wide. The whole structure was stiffened by many diagonals of heavy twine, and it weighed 15 pounds, and presented a flying surface of 170 square feet. This kite was flown with a 3-16-inch rope, running from a windlass. The kite rose steadily, flying at a high angle until over three-quarters of a mile of rope was reeled out. It was in the air continuously for six hours, and reached an altitude of nearly 2,000 feet, and proved very efficient. The only difficulty in handling resulted from the great tension of from 100 to 150 pounds, and the inefficiency of the reel to withstand a heavy strain. Mr. Smith's conclusions are that, in general, it is better for each kite to be attached to the main line by its own string, 100 feet or more in length, as it will then fly at the most effective angle. Kite flying is an interesting and exciting sport, and doubtless many amateurs will make kites this winter for use during the spring and summer.



VARIOUS TYPES OF MODERN KITES.

Elevator Air Cushions in a High Office Building.

Even with all the experience and skill which have been devoted to the study of elevator safety appliances, with the best material and workmanship, with the most rigorous and continuous systems of inspection, and with competent persons in charge, yet passenger elevators sometimes fall and cause more or less serious accidents. The manufacturer of elevators uses the best and most efficient safety devices he can obtain to control the movement of the car and to surely arrest it if a certain speed should be exceeded. The very nature of his business compels him to do this, because the result is financial embarrassment to him if his elevators drop occasionally. This applies with equal force to owners of buildings, who would have difficulty in securing tenants if the elevator apparatus were suspected of being dangerous. Many even go beyond the purely mechanical device and introduce a pneumatic arrangement as a last resort, only to be brought into action when all else fails.

The air cushion, located at the bottom of an elevator shaft, possesses peculiar inherent advantages which cannot be gainsaid. First, and most essential, it is always ready to perform its work instantly, and to do it successfully, under all conditions. Of itself, it cannot get out of order, since, practically, it is only a hole into which something may drop, some time. Whether the car dropped one or twenty stories, its movement would cease, not suddenly, but gradually, and without shock. The first cost of the air cushion is small and the outlay for its maintenance nil. It occupies space not otherwise valuable. All things considered, it is difficult to understand why it is not more widely employed.

One of the most extensive and elaborate applications of the elevator air cushion is to be found in the Empire building, New York. The building is a twenty-story office building, recently completed, and provided with all the most modern appliances and conveniences. There are ten elevators, of the high speed hydraulic type, arranged in two groups of five each. While nine of the elevators are distinctly for passenger service, one is more powerful and is capable of lifting safes weighing 8,000 pounds. Each shaft is entirely independent from the floor of the third story to the bottom, and is inclosed by walls which are not perforated except by the door openings. This forms the air cushion proper, which is about 50 feet in depth. The doors of the main floor and of the second floor are in two parts, which slide in recesses in the wall. These are of bronze and of ample strength to resist the air pressure that would come upon them if a car should fall. The usual open iron work is entirely absent on these two floors, solid masonry replacing it. The cars have also been strengthened with the view of resisting this pressure. The shaft walls are battered for a short distance below the third-story floor. The shaft at this point is 10 inches wider than the bottom, the batter extending just below the second floor. This provides a graduated air escape and adapts the cushion to any fall which the car may make. The car fits more closely in the lower portion of the shaft, the walls of which are vertical. It has been estimated that the air cushion should be in proportion of 1 to 6 of the travel; in the present instance the cushion is 50 feet and the travel 287 feet. In the bottom of each shaft is a suction valve which opens inwardly as the car ascends, thus preventing the vacuum which would result from the car leaving the cushion. There is also an escape valve, which opens outwardly into the atmosphere. It is so adjusted as to sustain the weight of a car under ordinary conditions, but will, in case of accident, relieve the cushion of undue pressure when the car falls. It has been calculated that the pressure in the air cushion, if a car should fall from the top, would be 3½ pounds to the square inch.

On July 18, a car weighing 2,000 pounds was dropped from the twentieth story. The efficiency of the cushion was shown by the fact that the eggs and incandescent lamps carried upon the floor of the car were uninjured.—Iron Age.

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Coal for the Navy.

The subject of coal for the navy has been of great importance since the war with Spain began, not because of danger to the vessels themselves, as was so strongly suggested in the recent case of spontaneous combustion in the bunkers of the battleship "Oregon," at the New York navy yard, but because of the apprehension that enough might not be obtained for the ships, in view of the effect of the neutrality laws. This question has been recently discussed by The Evening Post, from which we glean the following facts. There was no apprehension felt that there would be any famine in anthracite, of which the United States is, of course, the great producer; but inasmuch as nearly all the vessels of the navy are fitted with boilers and grate bars for the use of bituminous or soft coal, the problem was one that was feared might become vexatious, as the vessels would have to return to the United States or be supplied from colliers at sea. The situation was particularly embarrassing for Dewey's fleet, and for the "Oregon" and for the vessels of Schley's command when cruising in search of Cervera's fleet before it was safely locked up at Santiago. This is a great argument for coaling stations at a distance from home ports.

Recently the Anthracite Coal Association has made strong efforts to have the navy introduce that variety of fuel, without apparent success. It is claimed by the officers who were in the fleet that destroyed the Spanish vessels at Santiago on July 3 that it was the excellent American soft coal that enabled them to bring the vessels up to their highest efficiency, and that if the American ships had been using anthracite coal and the Spaniards bituminous, the latter would have gotten away from the American fleet. The subject of the relative values of anthracite and bituminous coal for the navy has been a matter of careful inquiry by the Navy Department for years, and a recent report says:

"When it is considered that nowadays one fleet under full steam might be alongside of another at anchor in a little more than an hour after they sighted each other, it will be seen that, even under heavily banked fires of anthracite, the fleet at anchor would be at a greater disadvantage for maneuvering; while with low and dirty fires, or with cold boilers, the destruction of that fleet could only be prevented by means extraneous to itself. Promptness of ignition may also be of vital importance on a lee shore, or in a sudden gale in a harbor, and under other circumstances. Nor is it in emergencies alone that rapidity of ignition is useful, for it gives much more uniform action in all steaming, since the fires quickly attain their maximum efficiency, instead of, as with anthracite, being almost inert for twenty minutes or more after each coaling. In short, the board is of opinion that this quality is so valuable in a naval vessel that it almost precludes the employment of anthracite in time of war, in favor of more free-burning coal, and that it has considerable advantages in time of peace also."

A narrow escape from disastrous fires in several war ships from spontaneous ignition of the coal would suggest that it was a very dangerous cargo. The examination into the causes of the spontaneous ignition on board ship shows that it is due primarily to the absorption by coal of the oxygen of the air. This raises the temperature of the coal and this augments the rate at which the oxygen is received. The increase of temperature so caused is rarely sufficient in itself to bring about spontaneous ignition in coal, but the oxygen itself becomes chemically active and in bituminous coal it combines with hydrogen and carbon, further raising the temperature, and if such action takes place in the center of a heap of small coal, a sufficient quantity of air being supplied, spontaneous combustion will probably follow. The introduction of high steam pressures, with the consequent increase of fireroom temperatures, has been followed by an increase in the number of cases of spontaneous ignition on ship board. It is also claimed that the pyrites in coal plays an important part in promoting spontaneous combustion.

Coaling stations have often been a subject of serious consideration, and the navy is now about to establish one at Pagopago, Samoa. This is the only landlocked port of refuge in the Samoan group and it is the best harbor among the islands of the Pacific. The war with Spain has demonstrated that coal is a contraband of war, and in time of war, when away from their home ports, United States steamers are practically useless for fighting purposes unless they can obtain coal from their colliers; so that coaling stations at various points are not only important, but are absolutely necessary.

Increase of Cancer in England.

In England four and a half times as many people die now from cancer as half a century ago, and no other disease can show anything like such an immense increase, W. Roger Williams says in The Lancet. "Probably no single factor is more potent in determining the outbreak of cancer in the predisposed than high feeding. There can be no doubt that the greed for food manifested by modern communities is altogether out of proportion to their present requirements. Many indications point to the gluttonous consumption of meat, which is such a characteristic feature of this age, as likely to be especially harmful in this respect. Statistics show that the consumption of meat has for many years been increasing by leaps and bounds, till it now has reached the amazing total of 131 pounds per head per year, which is more than double what it was half a century ago, when the conditions of life were more compatible with high feeding. When excessive quantities of such highly stimulating forms of nutriment are ingested by persons whose cellular metabolism is defective, it seems probable that there may thus be excited in those parts of the body where vital processes are still active such excessive and disorderly cellular proliferation as may eventuate in cancer. No doubt other factors co-operate, and among these I should be especially inclined to name deficient exercise and probably also deficiency in fresh vegetable food."

The Current Supplement.

The current SUPPLEMENT, No. 1200, marks the end of the forty-sixth volume of this unique publication, which was started twenty-three years ago. It contains many articles of exceptional interest. "Games Among Criminals and Savages" is a paper by the great criminologist, Prof. Lombroso. "How to Grow Mushrooms" is an illustrated article giving government directions for growing them. It is fully illustrated. "Roentgen Rays" is another original memoir by Prof. Roentgen. "The Engineer and His Work" is the presidential address of Charles Wallace Hunt, delivered before the American Society of Mechanical Engineers. "An Outline of the History of Geological Societies of America" completes this very interesting paper.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

HILLSIDE OR REVERSIBLE PLOW.—EDSON C. ROBINSON, Canandaigua, N. Y. A simple and durable jointer has been devised by this inventor, which is of duplex form, and is made in one piece, one point being a duplicate of the other, occupying, however, a reversed position, while the moldboards are in the same horizontal plane. An effective and light reversing device is also provided and a means whereby the jointer-standard will be inclined usually in a forward direction, the inclination permitting the jointer's being reversed at the rear of the standard, according to the direction of the inclination. A frog-box is likewise provided, which receives the pivot-post on the beam, and which obviates the present necessity of frequently removing the frog.

LAWN-MOWER.—MARK N. CORMACK, New York city. The mower of this inventor is provided with a series of separate individual cutters traveling in a continuous endless line and disposed in two oppositely moving runs, situated one above the other, in direct contact with each other, so that the edges of the cutters move directly past one another to perform the cutting. By the peculiar construction of the cutters, it is possible to cut grass of any height without danger of clogging the machine.

Bicycle-Appliances.

SPROCKET-CHAIN.—CHARLES J. COOK, New York city. The bicycle sprocket-chain patented by this inventor is especially designed for use on bicycles, and has alternate block and plate links. The block-links have oil-cups, by means of which every pintle can be lubricated. The chain may be readily separated, and is so contructed that the parts run easily without undue friction.

FOOT-PROPELLED VEHICLE.—THOMAS H. BROSNIHAN, Livermore Falls, Me. This vehicle is a tricycle, having a frame in the front end of which a steering wheel is fitted. On an axle carried by the rear end of the frame, wheels are mounted, one of which is fixed and the other loose. On the rear of the frame a seat is mounted. Crank-shafts in front of the axle are provided with gear-wheels, one of which meshes with a pinion on the axle. A clutch on the axle carries a pinion in mesh with the other gear-wheel of the other crank shaft. Arms are pivoted at their upper ends to the frame below the rear portion of the seat. Links connect the arms with the crank-shafts. Two pairs of foot-levers are pivoted at their lower ends to the forward part of the frame and project up in front of the seat. Links connect the foot-levers and arms.

STEERING-GEAR.—ARTHUR DOYLE, Seattle, Wash. The steering-gear forming the subject of this invention comprises a transverse fixed bearing; a slide mounted to slide thereon; and a link pivotally connected with the slide, and attached to the fork, and made in telescoping parts. When the slide is shifted to turn the wheel, the rider, by clamping both the slide and the bearing, can readily lock the slide in place until the turn has been made.

Electrical Contrivances.

LAMP.—WALTER S. DOE, Jersey City, N. J. This invention is an improvement upon a lamp patented by the same inventor. The improved lamp has a battery-jar formed with one or more cells, each containing an exciting fluid. A cathode in the form of a hollow perforated cylinder of carbon contains a suspended perforated tube of non-conducting material, within which tube an anode is adapted to be dropped. A contact-wire is held in the tube, and on it the anode rests. The contact-wire and the cathode are connected with the filament of the electric incandescent lamp.

Engineering Improvements.

LINK VALVE-GEAR.—JOHN A. ROST, Axtell, Neb. The purpose of this invention is to provide a link valve-gear for steam engines, which is arranged to produce a complete center action by placing the eccentric and valve in a true line at all times, thereby preventing undue friction and pinching of the parts under heavy pressure. The valve-gear is provided with a yoke adapted to be raised or lowered. To a link made in sections fastened together, trunnions are secured and mounted to turn in bearings on the yoke. Link-blocks fitted to slide in the link are connected with the valve-stem. Lugs projecting from the link are adapted to receive the pivot-pins for the eccentric-rod heads.

Mechanical Devices.

REGISTERING DEVICE.—JESSE ALEXANDER, New York city. This register is especially designed to be applied to type-writers, in order to show the number of folios written. The register is also applicable to all other purposes in which it is desired to keep a consecutive count. The spacing-bar of the type-writer is made to actuate a finger, playing over a registering dial, through the medium of ratchet wheels and levers. By pressing down upon the central spindle, the locking devices are thrown out of engagement with the registering mechanism, thus enabling various springs to return the registering mechanism to its initial position.

LOCK.—ALBERT E. ORMOND, Winnipeg, Canada. The purpose of this invention is to provide a lock which may be freely operated by the knob at the inner side of the door, but which cannot be operated from the outside without first manipulating a predetermined combination. The lock comprises a series of notched tumbler-disks, means for imparting a step-by-step rotary movement to the tumbler disks, a spring-pressed dog controlled by the tumbler, a bolt-actuating plate, an outer knob, a clutch operated by a movement of the dog to put the outer knob in operative position with the plate, and an inner knob having connection with the plate, whereby the bolt may be operated by rotating the inner knob.

Railway-Appliances.

AUTOMATIC RAILWAY-GATE.—DOSITHE BERNARDIN, St. Eustache, and ZENOPHILE PATTENAUDE, Winnipeg, Canada. These inventors have devised an apparatus which is automatically operated by a railway-train or its motor to close a highway-crossing of a railway before the approach of a train, and to open the crossing after the train has passed. The apparatus consists of two principal parts: an improved operating mechanism which is provided with a bar so placed as to be engaged by the tread of the wheels, and a novel gate or closing mechanism, which is operated by the bar through the medium of connecting mechanism. The gate being entirely automatic in operation, dispenses with the use of a gateman, and thus removes the danger of accidents resulting from the carelessness of the men placed in charge of the usual railroad-crossing gate.

RAILWAY TIME-SIGNAL.—HENRY J. WEMETT, Lima, N. Y. In this improved device a signal is operated in such a manner that it will clearly indicate to an engineer what length of time has elapsed since the preceding train passed a certain point. The signal comprises a clock-mechanism adapted to be mounted adjacent to the track. The mechanism is provided with an easily visible clock-face and dial, and with a hand which may be freed from the clock-mechanism and returned to zero by the action of a trip operated by a passing train.

CAR-COUPLING.—WILLIAM C. SHAW, White Plains, Md. The improved pivoted jaw-coupler patented by this inventor has a lateral shoulder and a coupling hook pivoted on one side of the draw-head. A locking or safety catch is pivoted on the opposite side of the draw-head, adjacent to the shoulder, and is adapted to engage the coupling hook. Uncoupling is effected by the use of a lever and rod without difficulty or danger, and the coupling devices may be set in position to hold them out of action by the same means employed in uncoupling. The car-coupler is designed automatically to couple cars on the shortest curves as easily as on straight tracks.

RAILWAY-CROSSING SIGNAL.—JOHN D. TAYLOR, Chillicothe, Ohio. This invention seeks to provide an automatic alarm-signal to be placed at a railway-crossing, which signal will sound an alarm when a train is approaching the crossing; but only when the train is actually approaching and not when it is standing or backing. The invention consists in the novel arrangement of a signal-sounding mechanism; an open track-circuit at one side of a crossing; a resistance connecting one portion of the track-circuit with another, the resistance diminishing as they approach the crossing; a primary coil in the track-circuit; a secondary coil operating by an induced current from the primary to actuate the signal; and another primary to bring the signal to rest.

Miscellaneous Inventions.

TEMPLE FOR LOOMS.—PATRICK DUFFY, New Bedford, Mass. By means of this invention, cloth may be drawn longitudinally and kept properly extended in a transverse direction to permit the filling to be properly beaten in by the lay without injury to the cloth and without danger of the selvage's chafing. A ribbed roll is employed, which turns but does not slide axially. On this roll a ribbed loose cover is superimposed, between which and the roll the fabric passes. The cover automatically adjusts itself according to the pull on the cloth and its thickness, so that there is no strain on the loose cover when pulling transversely on the cloth. The cloth, consequently, is not jammed against the ribs of the roll. The roll is thus permitted to revolve freely with the forward movement of the cloth.

DRESS-STIFFENER.—MINNIE T. SELLERS, New York city. Stiffeners made of wire, reed, or whalebone are objectionable because they become easily broken and the projecting ends are liable to tear the clothing. The present stiffener, in order to be free from these faults, is made of a facing of fabric to which a strip of haircloth is secured, having one edge folded upon and extending partly across the main portion of the material. A greater rigidity is thus obtained at one edge of the stiffener than at the other, whereby a skirt may be made to hang better than would otherwise be possible.

LOCKING DEVICE FOR TELESCOPING-BOXES.—OLIVER B. HICKS, Chicago, Ill. This invention seeks to provide an improved locking device for telescoping cases such as are used by commercial travelers. The device comprises a combined ratchet and guide plate; a casing having a sliding engagement with the guide; a bolt fitted to slide in the casing and adapted to engage the ratchet-plate; a spring-pressed lever engaging the bolt to withdraw it; a finger-piece to actuate the lever; and a locking-lever actuated by a key and arranged to swing into the path of the bolt to lock it against withdrawal.

BOOK-SHELF BLOCK-CASE.—ADELBERT E. FOUTCH, New York city. The case is especially designed to receive photographic views, and is so constructed that it may be used as a book-shelf block to hold books in place. The case has an unbroken front wall and is open at the rear. Drawers are mounted in the case and may be withdrawn from the rear. A spring-actuated presser-plate is hinged to the upper front edge of the case and lies over the top thereof to engage the shelf above the case and to hold the case in place. The presser-plate has flanges at its side and rear edges, which flanges project down outside of the upper portion of the case. When in place, the case cannot be distinguished from the usual book-shelf blocks.

NON-REFILLABLE BOTTLE.—EDWIN WILBUR, Newport, R. I. In making non-refillable bottles after the design of this inventor, a valve-seat is formed in the bottle-neck, and a ring is fitted above the valve-seat and provided with a central cup projecting down within the ring and connected with the upper portion of the ring by arms. A ball is adapted to be seated in the valve-seat. The ball will drop into the cup whenever the bottle is turned up. When the bottle is turned right side up, the ball will drop into its seat and prevent the entrance of all liquid.

FENCE-POST.—ARPHAD SNELL, Tice, Ill. The purpose of this invention is to provide a clay fence-post and a simple means for securing the wires thereto. The fence-post is provided with a series of transverse notches and an opening below the lowermost notch. A binding strip crosses the notches in the post and is provided with a flange at its lower end, which flange enters the opening in the post. A flange at the upper end engages with the top of the post. Clamps secure the binding strip to the post. The wire which forms the fence is passed around the end post between the post and the

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binding strip, and enters the notches or grooves. The wires are then twisted around the strands and the strands secured to the intermediate posts.

AUTOMATIC WAGON-BRAKE.—ORION A. LITTLE, Oxford, Kans. To provide an automatically-operated mechanism by which a wagon is made to stop when running forward upon the horses, this inventor has devised a brake having a shaft with a gear thereon. An intermeshing gear is rotated from a carriage-wheel. A drum is loosely mounted on the shaft, and a spring-held clutch-mechanism is adapted to connect the drum with the shaft. A cable fastened to the drum is connected with the brake, and connections from the shaft-mechanism to the clutch separate the parts by the operation of the draft-mechanism. The brake is applied by a forward motion of the wagon and is released by the team's pulling forward upon the double-tree.

GATE. — WASHINGTON CROSS, Roseland, La. The gate of this inventor is mounted to swing on a vertical axis and is provided with a latch-mechanism and with devices by which the latch is operated in order to enable the gate to open. The devices in question comprise an operating lever fulcrumed on the gate-spindle and having connection at one end with the gate. A bell-crank lever is mounted in the other end of the lever and is connected with the gate-latch. An anti-friction roller having stationary bearings is engaged by the spindle of the bell-crank lever. In opening the gate, a cord is pulled, whereby the spindle is turned to cause the bell-crank lever to turn and release the latch. The gate will then be canted and swung open by gravity.

ATTACHMENT FOR PAPER-COATING MACHINES.—WILLIAM H. WALDRON, New Brunswick, N. J. In this attachment, two brushes are adapted to have the web of the stock passed between them and to be driven transversely of the web, so as to treat the stock as it passes between the brushes.

APPARATUS FOR HANDLING FABRICS.—HAMILTON K. PARRY, Lucas, Ohio. An apparatus on which rolls of fabric may be mounted, displayed, unwound, and measured, has been patented by this inventor. The fabric is mounted between cleats on rods or rolls, is laid over a cutter-bar, and extended over a rack by which it may be profitably displayed. When it is desired to cut off a portion of the fabric, the roll upon which it is carried is unwound. By means of a tape-measure carried on the frame of the apparatus, the fabric is measured, and, with the assistance of the cutter-bar and a knife, is cut from the roll.

FIREPLACE-FENDER.—LORENZO P. LEGG, Jefferson, Ga. This invention provides an improved fender adapted to be transferred from one fireplace to another, to be adjusted to permit free access to the fire, and to prevent the flying of sparks. The fender has two side frames, each embodying a top rail and a bottom rail. Each bottom rail has a forwardly-extending hook and each top rail has a pivot. The front frame of the fender has two side bars rigidly joined by horizontally-extending front bars, each side bar having a slot in which the pivots of the side frames are received. The lower end of each bar is adapted to be removably engaged with the hooks of the bottom rails of the side frames. A keeper-sleeve slides on each top rail of the side frames. The front frame and side frames are covered with wire netting. The front frame may be rocked up when it is necessary to clean the furnace.

GREAT CIRCLE COURSE-INDICATOR.—STEPHEN R. KIRBY, New York city. The arc of a great circle being the shortest distance between two points, navigators generally prefer to sail on such an arc. From the many charts now in existence it cannot be readily determined by most shipmasters on what course they should sail. The present device overcomes this difficulty. The apparatus consists of an equatorial arc connected with meridian-arcs. The meridian-arcs are connected with a polar pivot, so that the meridians may be swung to any desired point. The polar pivot is also mounted upon a meridian-plane so pivoted at a point representing the center of the earth, that the pole may be swung in this meridian-plane to adjust the device for any latitude. Passing through a central point representing the ship's position, is a great circle arc which has a pivot located in the meridian-plane and extended toward the center upon which the plane is pivoted. The distance between two points upon the arc of a great circle may be read from the great circle arc.

ADJUSTABLE DENTAL RUBBER DAM CLAMP.—ARTHUR S. COOPER, McMinnville, Ore. The dental device patented by this inventor is provided with a clamp which will grasp and tightly hold the tooth to which it is applied, regardless of the location of the cavity. An adjustable arm can be employed in connection with the clamp for working purposes, the arm and the clamp being adjustable vertically, laterally and to and from the tooth.

THERMOCAUTER-LANCET. — Dr. WILLIAM H. BEACH, Bridgenorth, England. This invention provides an instrument which may be used for surgical purposes and for pyrographic etching on glass. The working point of such thermocauters is usually made of platinum, and often adheres to the fused particles of glass. Iridium, being free from this objection, is used by the inventor in his instrument. An improvement is provided by which the transmission of heat from the incandescent point to the hydrocarbon vaporizing chamber forming the handle of the instrument, is more effectually prevented than hitherto. In order that the mixture of air and vapor may be properly dosed, air is blown directly into the passage leading to the combustion-chamber, without first passing through the vaporizing chamber.

GATE.—WILLIAM A. WHITCOMB, Downs, Ill. This gate is provided with posts located near the gate and carrying levers projecting at opposite sides of the gate. The levers are connected through links with the latch of the gate. By pulling upon one lever the gate is unlocked and opened; by pulling upon the other lever the gate may be closed. Gates thus constructed are especially adapted for farms and country-seats.

PIN-HOLDER. — ALBERT E. ORMOND, Winnipeg, Canada. The pin-holder of this inventor is so constructed that a strip of paper containing pins is automatically fed to bring the pins, one at a time, to a discharge-opening, through which they are forced by a lever. The device may also be used as a paper-weight for use upon desks.

DOOR-HANGER.—RICHARD B. BROWNE, New York city. This invention is an improvement in means for suspending a door from a track-rail so as to permit the door to be readily moved along the track-rail. To this end an anti-friction, self-leveling door-hanger has been devised, comprising two spaced oppositely-slotted side plates; a journaled sheave, the journals of which project loosely into the slots; and an eyebolt whereon the lower ends of the side plates are pivoted, the eyebolt being adapted to hang a door in place.

SNOW-PLOW.—CYRILLE DUFF, Millbury, Mass. The body of this plow consists of two shovel-blades joined at an angle. The lower edges of the blades at the point of the nose extend beyond the upper edges, while the upper edges of the blades overhang the lower edges from a point near the center to their rear ends. Rearwardly-extending tapering pockets are formed in each blade. Correspondingly-tapering screws are held to turn in the pockets, and carry the snow back, keep the blades properly cleaned and cause the bulk of the snow to be delivered at the rear ends of the blades.

Designs.

SKIRT-PROTECTOR.—HUGO MAUL, Rahway, N. J. This skirt-protector has a head with a plain upper edge; a brush hanging from the lower edge of the head; and two rows of spaced ornaments, extending transversely of the head and raised on the sides of the head.

COVERED DISH.—ADOLPH PAROUTAUD, New York city. The body of this dish is depressed near its base and formed with a horizontal ridge between the base and the depression. The surface between the ridge and the top edge of the body is given an outward swell. The handles of the dish and cover are ribbon-like in form. The body and cover are decorated with raised figures.

FOOT FOR STOOLS. — WILLIAM R. SHAW, New York city. The body members of this design combine at their converging ends to form a foot member. The upper ends of the body members diverge and are furnished with oppositely extended arms, so as to permit the foot to be readily secured to a stool.

CARPET. — ALFRED BUNEL, New Rochelle, N. Y. This design consists of a central bouquet of flowers and foliage, the flowers being roses and daisies. Smaller bouquets of similar flowers and foliage are grouped around the main figure.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for 10 cents each. Please send the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

RAILWAY ENGINEERING, MECHANICAL AND ELECTRICAL. By J. W. C. Haldane. With many plates and other illustrations. London: E. & F. N. Spon, Limited. New York: Spon & Chamberlain. 1897. Pp. 562. Price $6.

The volume before us is of a popular nature, and is largely made up of pictures of machine tools, wood working tools, rolls, hammers, engines, boilers, etc., and as it is written in popular style intended for the lay reader it will doubtless appeal to many readers. Various railways and railway plants are considered and the subjects of bridges, electric railways, locomotives, boilers, etc., are taken up. The volume is freely illustrated.

THE THETA-PHI DIAGRAM. Practically Applied to Steam, Gas, Oil, and Air Engines. By Henry A. Golding. London: John Heywood. Manchester: The Technical Publishing Company, Limited. 1898. Pp. 127. Price 3 shillings net; $1.25.

In the present volume the author has presented in as simple and practical manner as possible the use of the temperature entropy diagram and the various methods of drawing it for different heat motors. Most of the literature upon the subject has presented the mathematical rather than the graphical side of the question, with the result that the students have become afraid of bothering with what they believe to be an intricate mathematical investigation. The present volume will do much to disabuse their minds of this idea, and all engineers and gas engine men will find it eminently useful.

AN INTRODUCTION TO MACHINE DRAWING AND DESIGN. By David Allan Low. Eighth Edition. Revised and Enlarged. New York and Bombay: Longmans, Green & Company. 1898. Pp. 187. Price 75 cents.

A most practical work upon machine drawing and design is before us. We have rarely seen a book of the same compass which contains so much valuable information regarding the essentials which all draughtsmen should know. As an introduction to mechanical drawing, either alone or supplementary to other books, it is to be recommended. It is unfortunately tangled up by the examination papers of the Departments of Science and Arts. Fortunately, we have nothing of this kind to hamper our progress in this country, and this section of the book, which is less than twenty pages, may be disregarded by the student.

BULLETIN OF THE UNITED STATES GEOLOGICAL SURVEY. No. 149. Bibliography and Index of North American Geology, Paleontology, Petrology, and Mineralogy for 1896. Weeks. Washington: Government Printing Office. 1897. Pp. 152, ix.

BULLETIN OF THE UNITED STATES GEOLOGICAL SURVEY. No. 89. Some Lava Flows of the Western Slope of the Sierra Nevada, California. Ransome. Washington: Government Printing Office. 1898. Pp. 74, ix.

BULLETIN OF THE UNITED STATES GEOLOGICAL SURVEY. No. 88. The Cretaceous Foraminifera of New Jersey. Bagg. Washington: Government Printing Office. 1898. Pp. 89, ix.

Business and Personal.

The charge for insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in the following week's issue.

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Notes & Queries

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Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(7538) H. W. asks: 1. What is the best insulating compound to apply on armature? I have used shellac, but after the machine has been run for an hour or so the shellac begins to blister. A. The bars of an armature should be separated from each other by mica. If the insulation has been destroyed, it cannot be permanently repaired by any liquid insulator. The proper remedy is to have the armature taken apart so far as is necessary and new insulation put in as when it was built. 2. What is the most reliable material to put on a pulley to stop belt from slipping? A. A piece of beeswax rubbed on the belt and pulley occasionally is probably the best application that can be made.

(7539) F. A. M. asks: 1. Is there anything better or more adhesive than shellac for cementing the convolutions of the armature coils together on simple electric motor? A. There is nothing better than shellac for coating coils after they are wound. It is one of the best insulators and is quite strong when well dried. You can tie the coils with a cord. 2. Would it do any harm to put a few coats of furniture glue on the coils? A. The objection to the use of glue to bind the wires together is that it will soften if it is in a wet place at any time. If it absorbs water, the insulation is injured.

INDEX OF INVENTIONS

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DECEMBER 20, 1898,

AND EACH BEARING THAT DATE.

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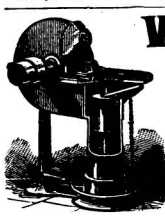

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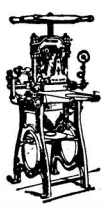

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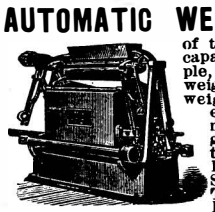

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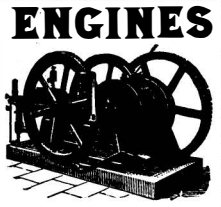

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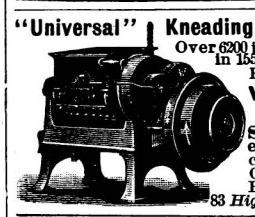

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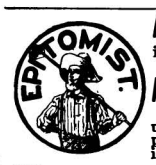

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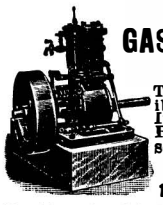

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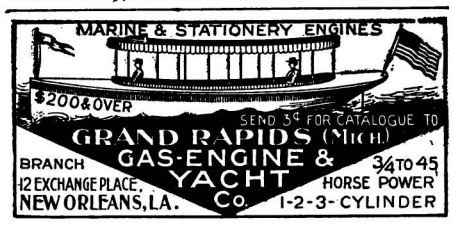

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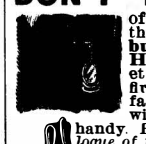

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